US007561793B2

(12) **United States Patent**
**Brost**

(10) **Patent No.:** **US 7,561,793 B2**
(45) **Date of Patent:** ***Jul. 14, 2009**

(54) **USER INTERFACE FOR CONTROLLING CROPPING IN ELECTRONIC CAMERA**

(75) Inventor: **Randolph C. Brost**, Albuquerque, NM (US)

(73) Assignee: **Eastman Kodak Company**, Rochester, NY (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 700 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/106,825**

(22) Filed: **Apr. 15, 2005**

(65) **Prior Publication Data**

US 2005/0174462 A1 Aug. 11, 2005

**Related U.S. Application Data**

(63) Continuation of application No. 10/292,235, filed on Nov. 12, 2002, now Pat. No. 7,006,764.

(51) **Int. Cl.**
***G03B 13/10*** (2006.01)
***G03B 17/00*** (2006.01)
***H04N 5/222*** (2006.01)
***H04N 5/225*** (2006.01)
***H04N 5/262*** (2006.01)

(52) **U.S. Cl.** ......................... **396/380**; 396/436; 348/64; 348/240.1; 348/333.09; 348/333.12; 348/341; 358/909.1

(58) **Field of Classification Search** ................. 396/380, 396/84, 141, 148, 311, 378, 379, 429, 435, 396/436; 348/64, 240.3, 220.1, 240.99, 240.1, 348/240.2, 333.01, 333.02, 333.03, 333.11, 348/333.12, 341; 358/906, 909.1
See application file for complete search history.

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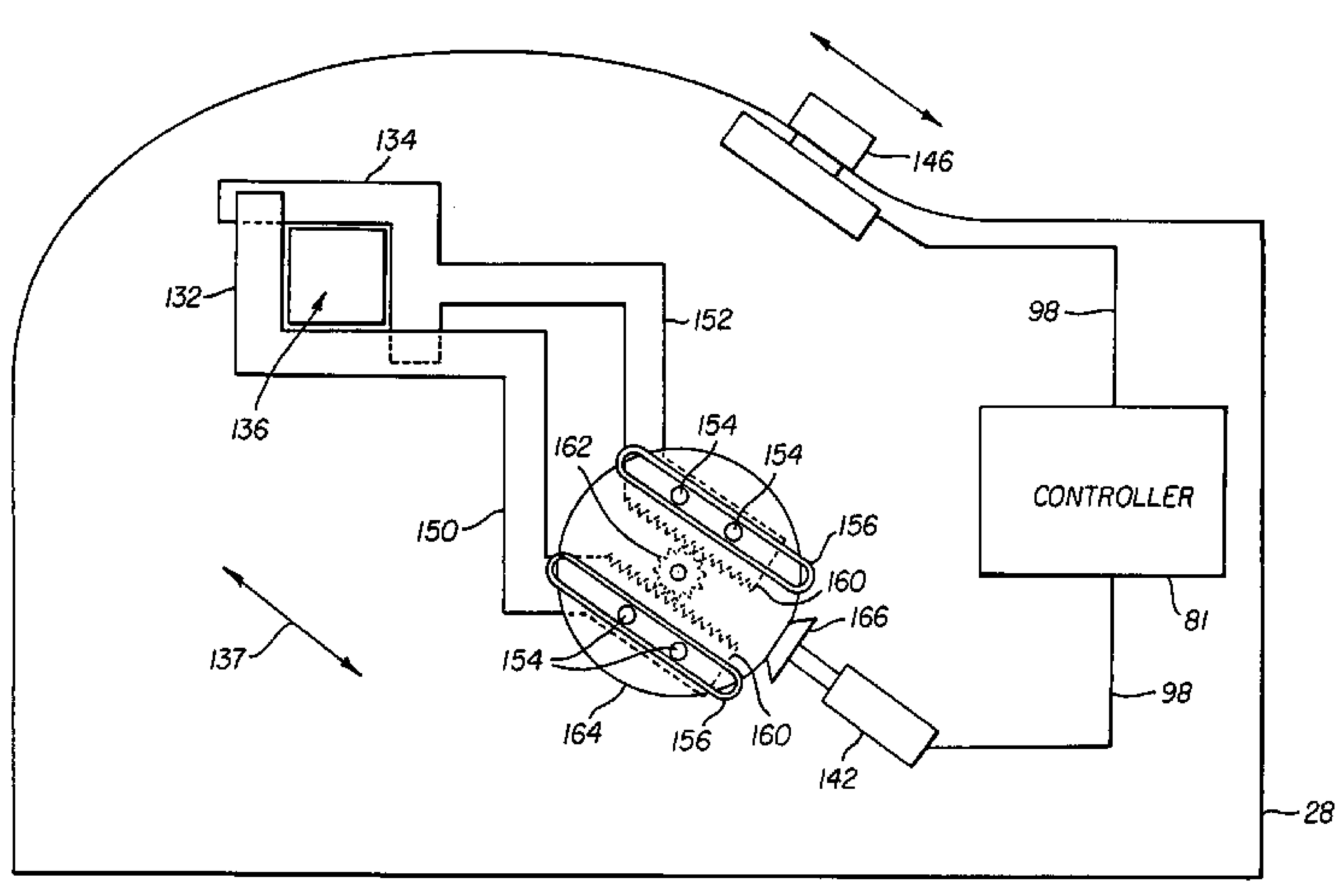
*Primary Examiner*—Rochelle-Ann J Blackman
(74) *Attorney, Agent, or Firm*—Peyton C. Watkins

(57) **ABSTRACT**

A camera adjusts the aspect ratio of a viewfinder image. The camera has a body and a capture unit mounted in the body. The capture unit has an imager and storage media operatively connected to the imager. The capture unit selectively captures an electronic image of a scene. A viewfinder of the camera displays a light image of the scene. A cropper is disposed in the body. The cropper is switchable among a plurality of settings. Each setting defines a different rectangular cross-sectioned window in the viewfinder. A cropping control is operatively connected to the capture unit and cropper. The cropping control has a cropping input element that is accessible external to the body. The cropping input element is movable between first and second opposed cropping control positions to change the settings. The cropping control positions define a cropping control axis perpendicular to an optical axis of the capture unit.

**11 Claims, 30 Drawing Sheets**



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| WO | WO 02/27640 | 4/2002 |

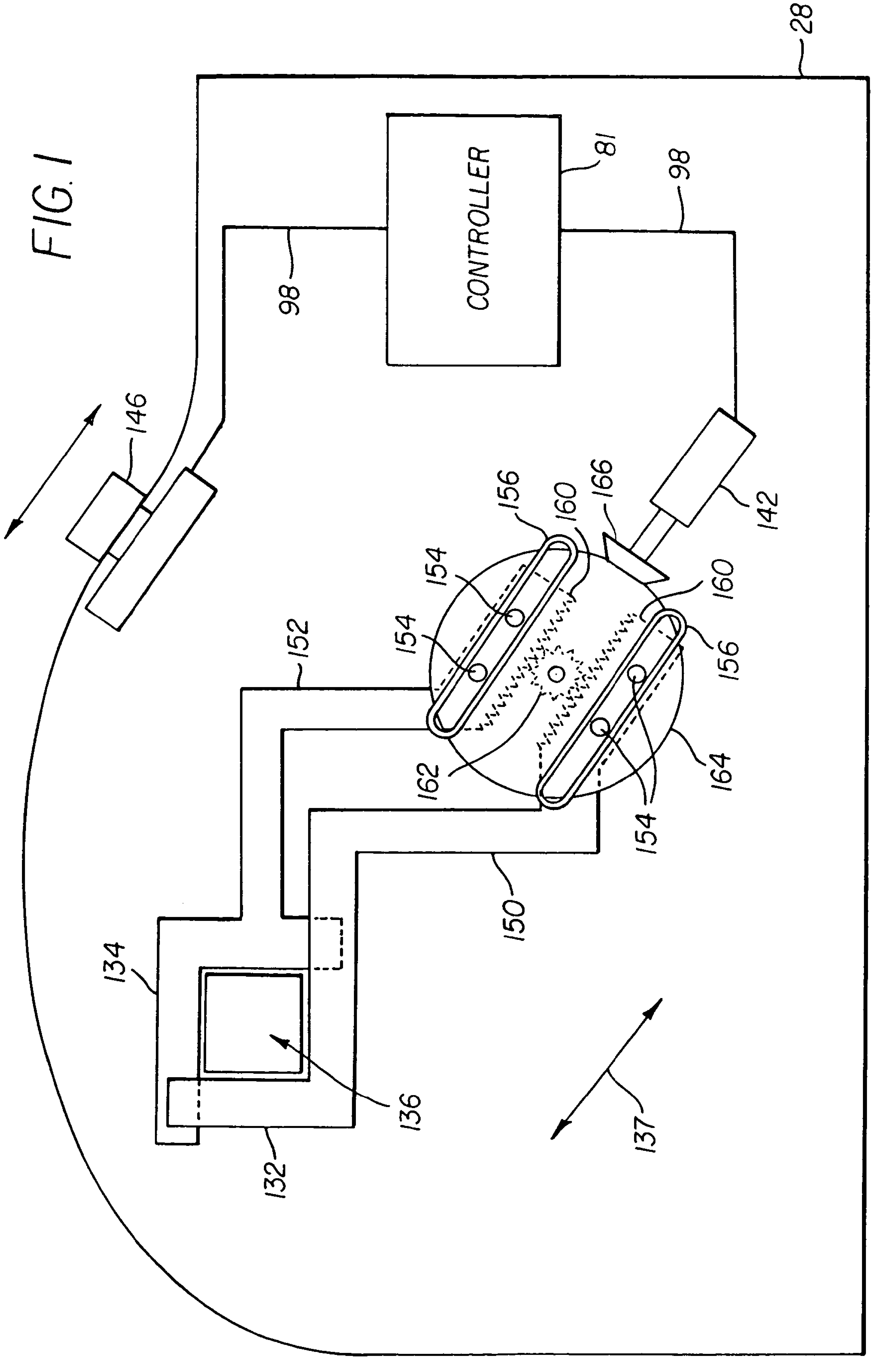
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FIG. 1

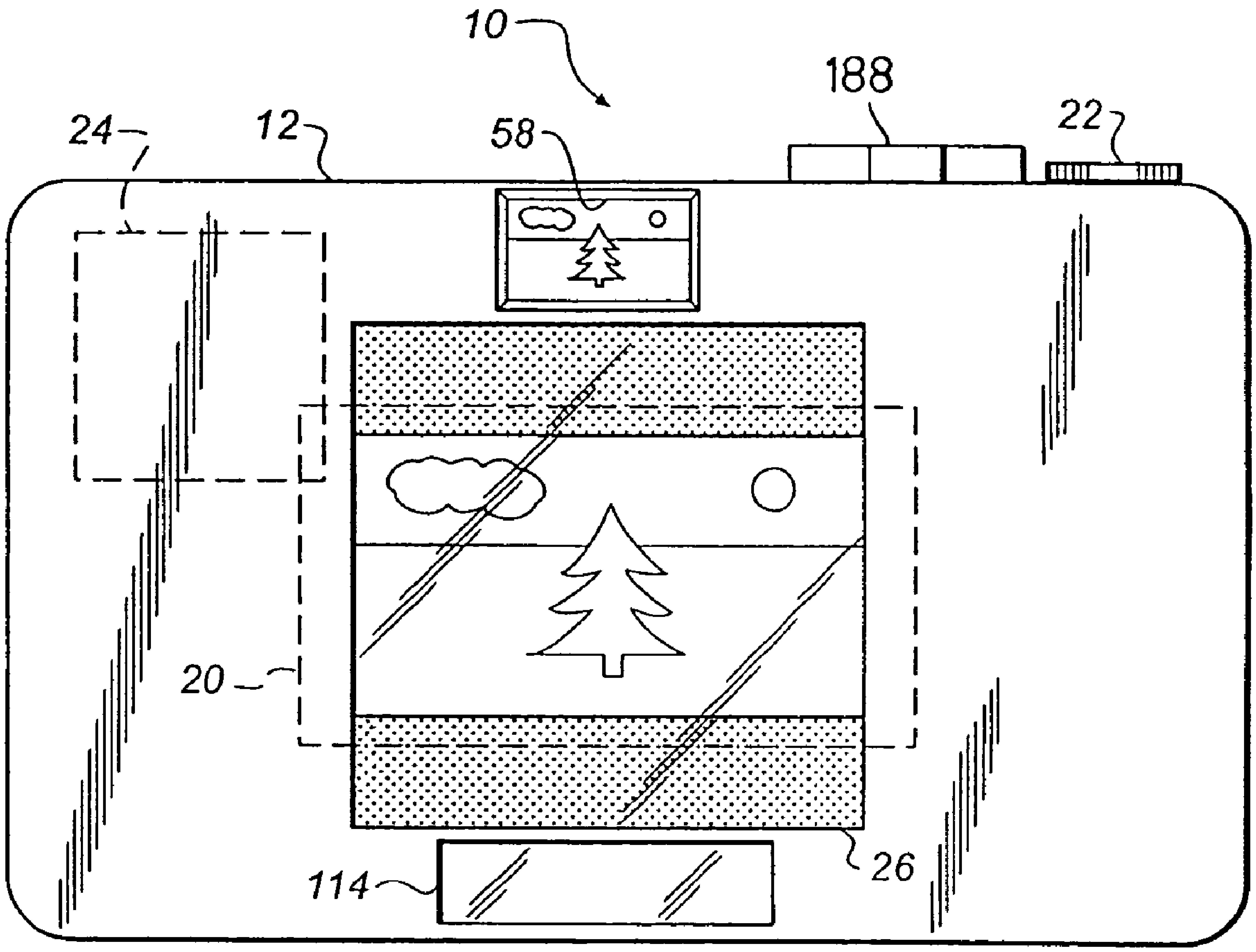


FIG. 2

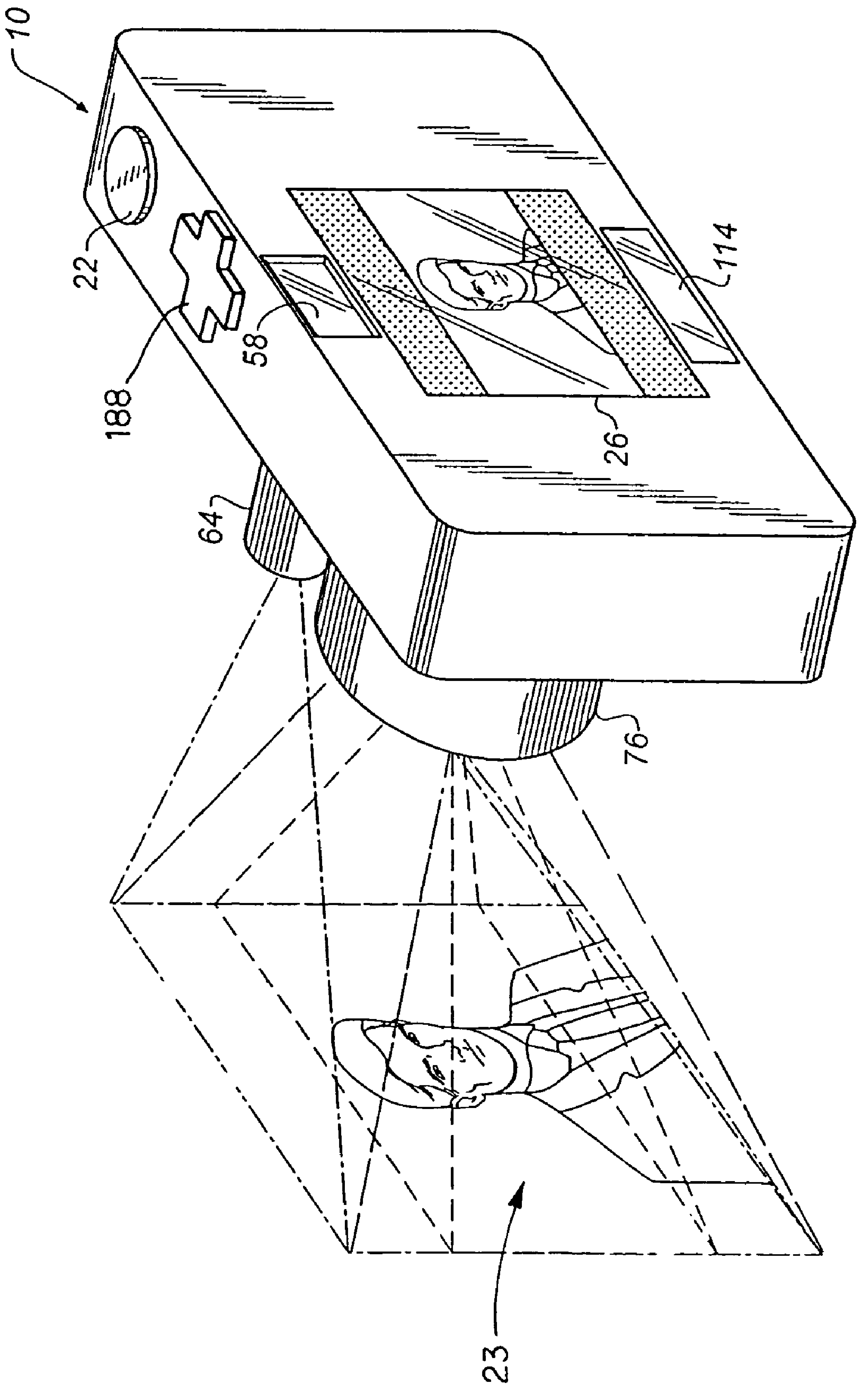


FIG. 3

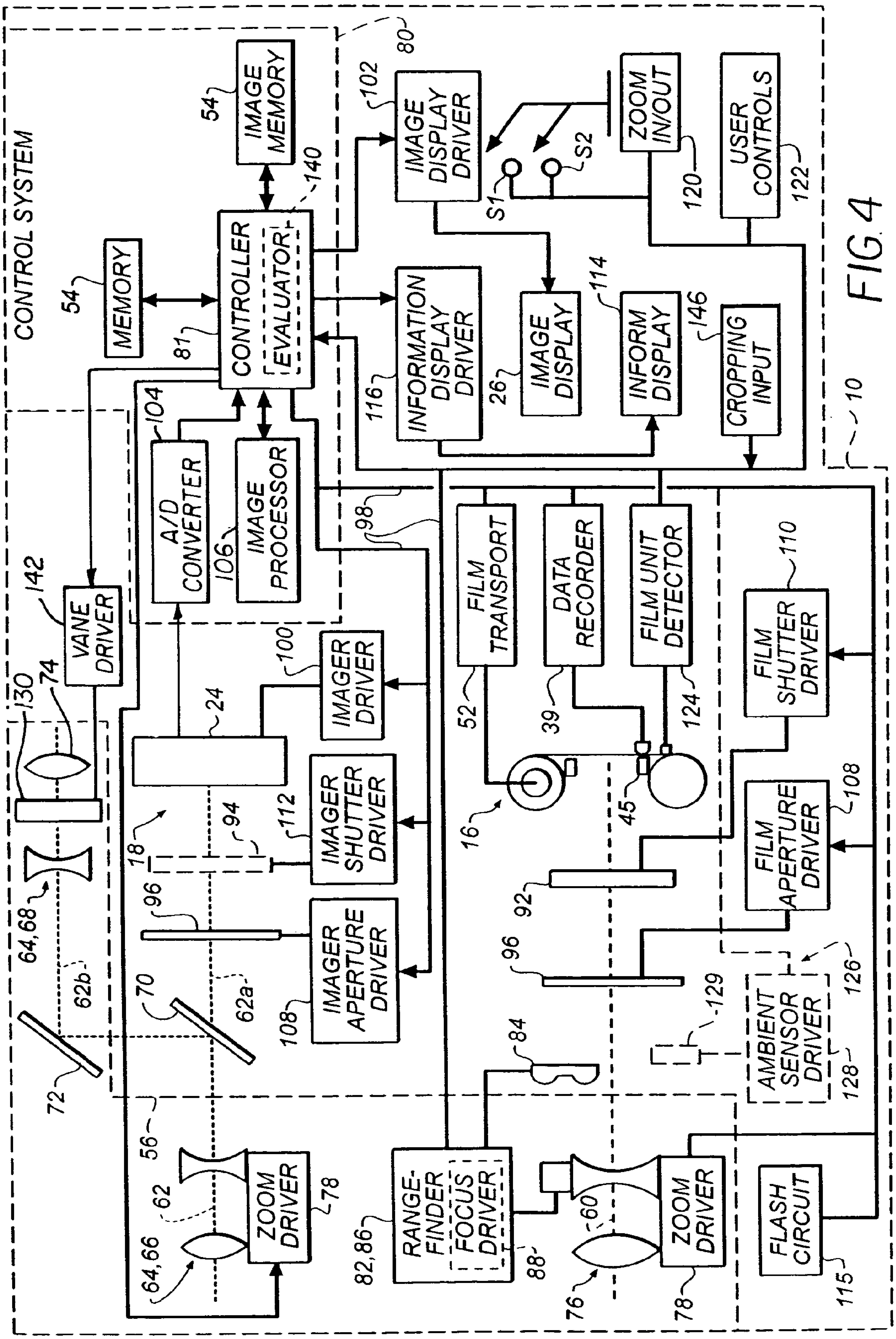
CONTROL SYSTEM
MEMORY
IMAGE MEMORY
CONTROLLER
EVALUATOR
IMAGE DISPLAY DRIVER
INFORMATION DISPLAY DRIVER
IMAGE DISPLAY
INFORM DISPLAY
ZOOM IN/OUT
USER CONTROLS
CROPPING INPUT
S1
S2
A/D CONVERTER
IMAGE PROCESSOR
VANE DRIVER
IMAGER DRIVER
IMAGER SHUTTER DRIVER
IMAGER APERTURE DRIVER
FILM TRANSPORT
DATA RECORDER
FILM UNIT DETECTOR
FILM SHUTTER DRIVER
FILM APERTURE DRIVER
AMBIENT SENSOR DRIVER
RANGE-FINDER
FOCUS DRIVER
ZOOM DRIVER
ZOOM DRIVER
FLASH CIRCUIT
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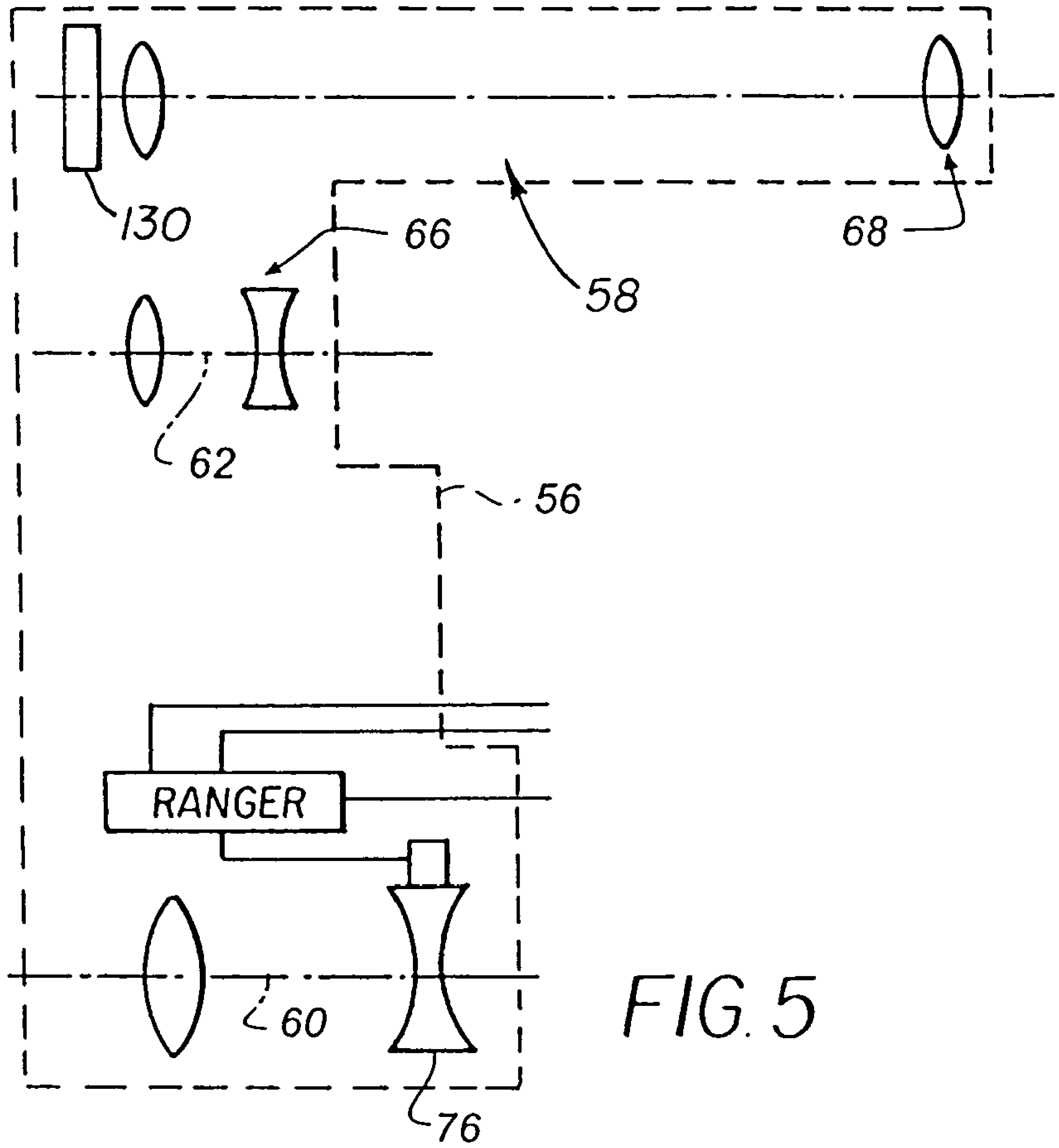
FIG 4

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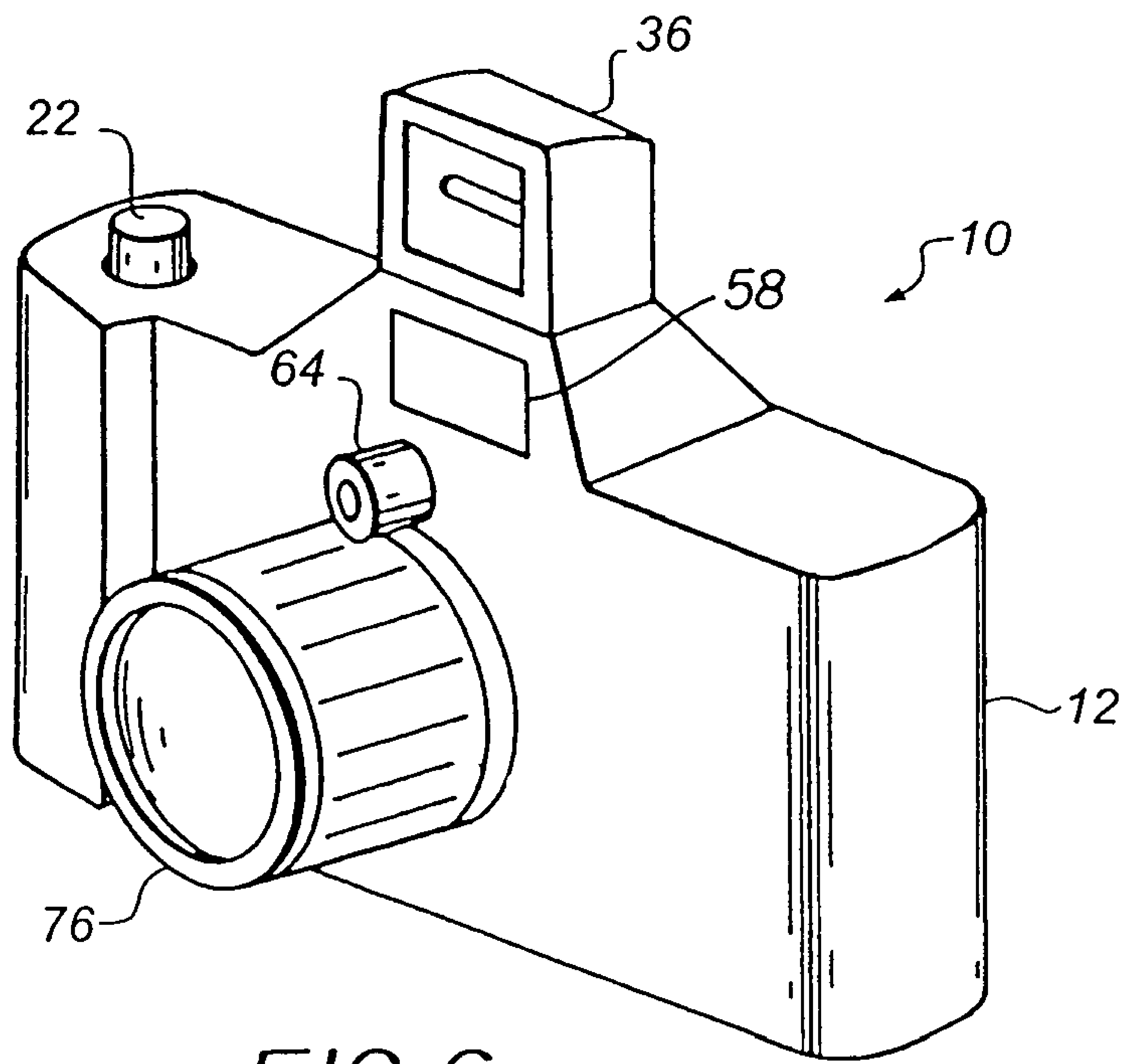


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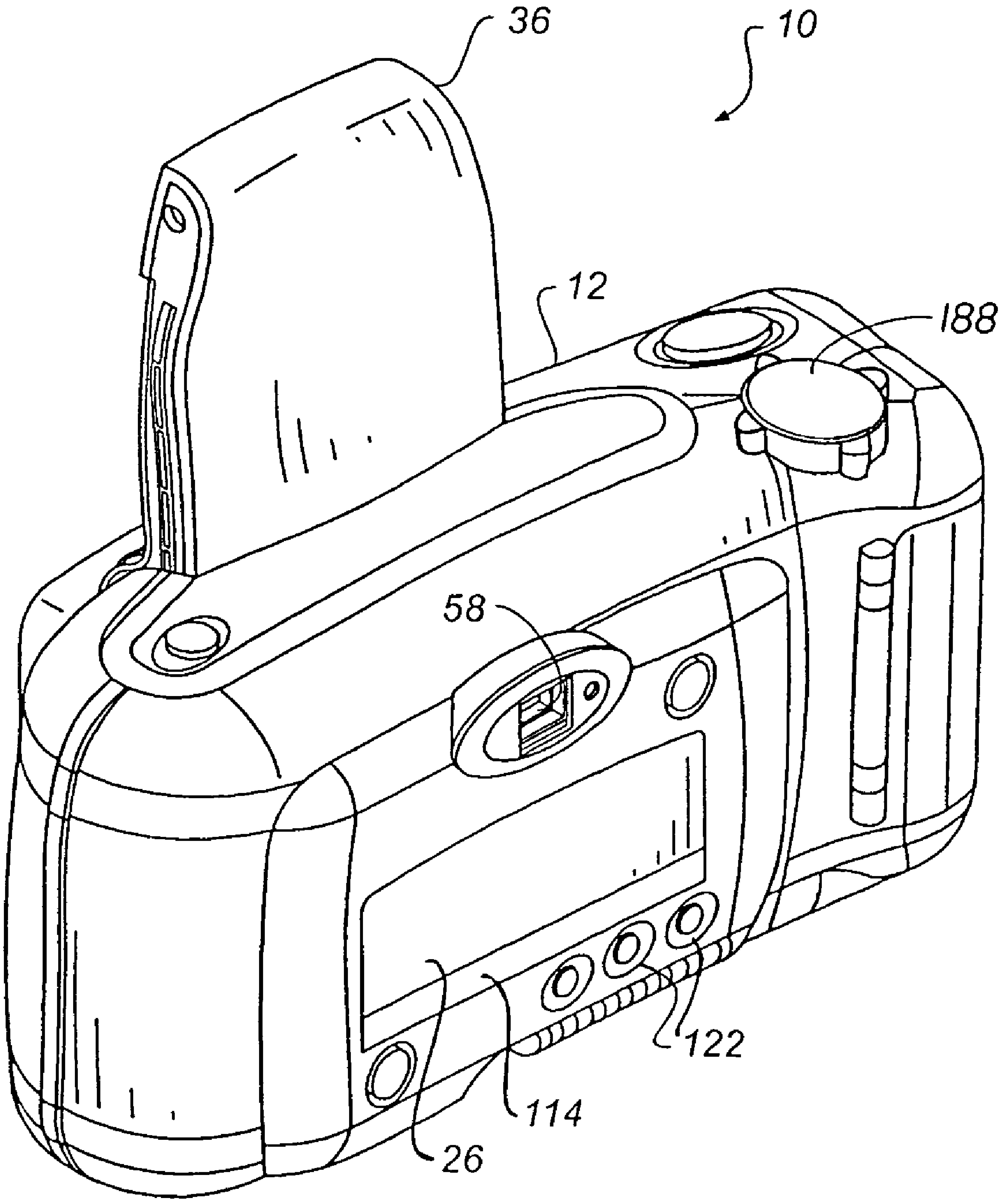


FIG. 7

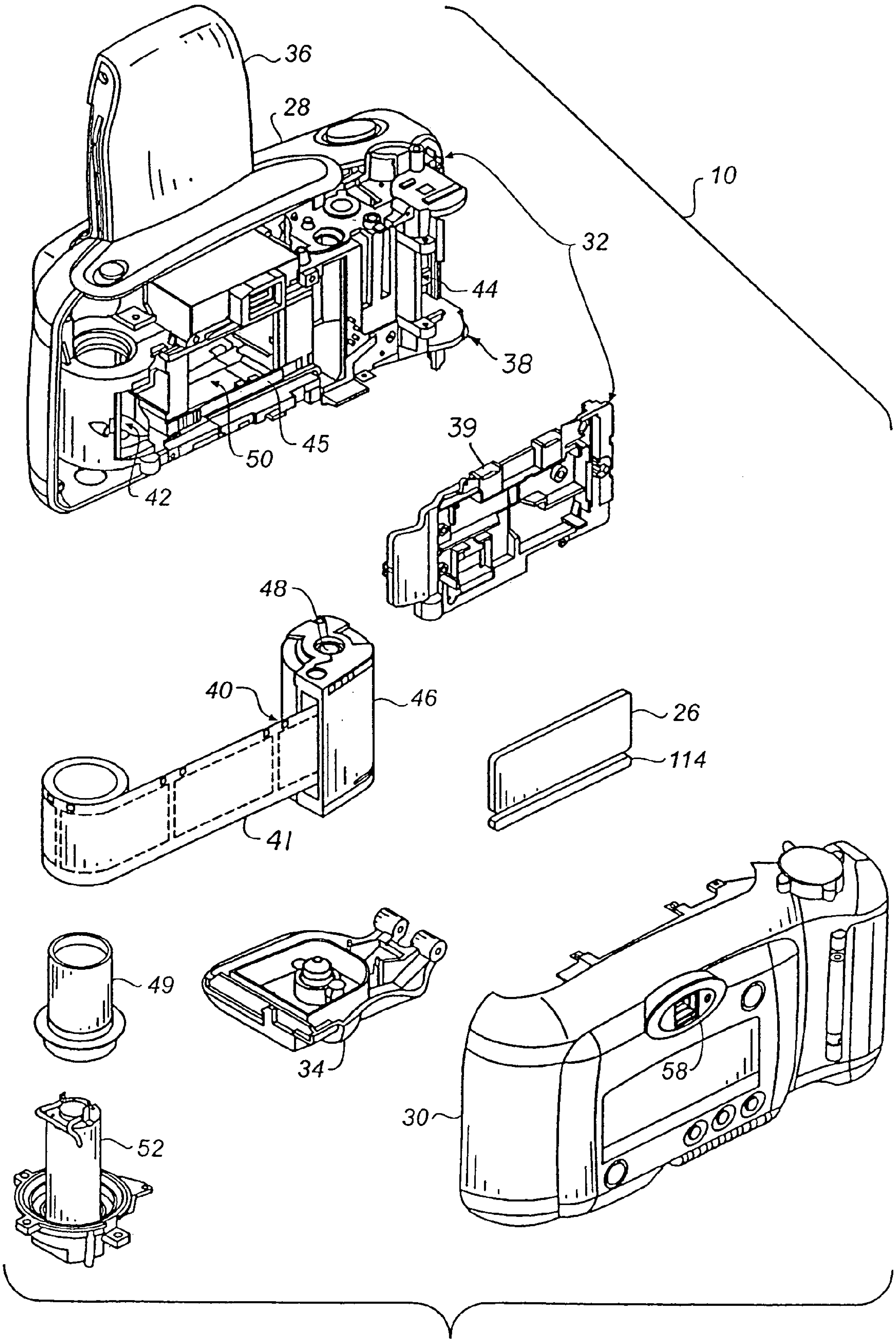


FIG. 8

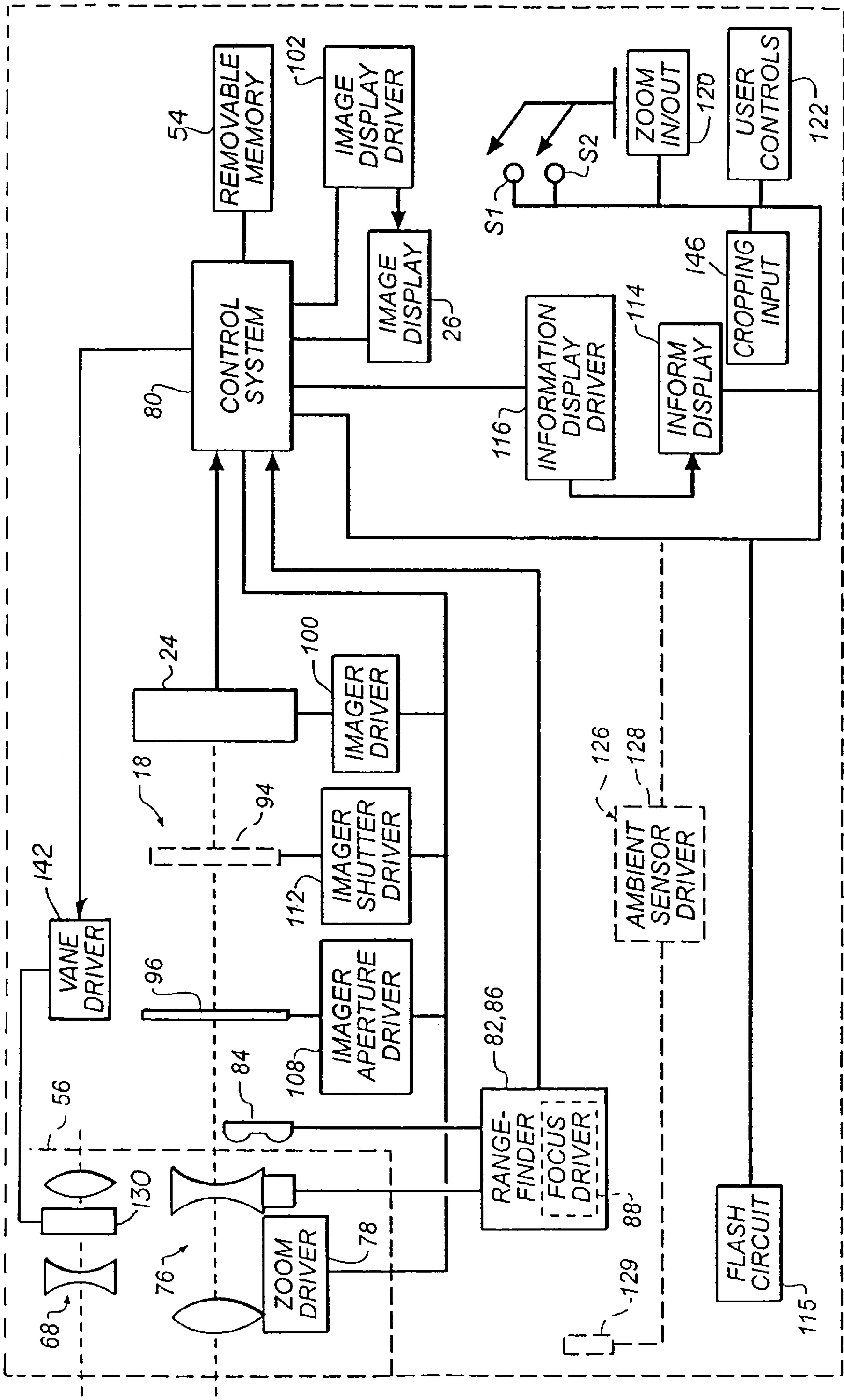
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IMAGE DISPLAY DRIVER
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ZOOM IN/OUT
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USER CONTROLS
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S1
S2
CONTROL SYSTEM
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IMAGE DISPLAY
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INFORMATION DISPLAY DRIVER
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INFORM DISPLAY
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CROPPING INPUT
146
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IMAGER DRIVER
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IMAGER SHUTTER DRIVER
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AMBIENT SENSOR DRIVER
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VANE DRIVER
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IMAGER APERTURE DRIVER
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82,86
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RANGE-FINDER
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ZOOM DRIVER
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FLASH CIRCUIT
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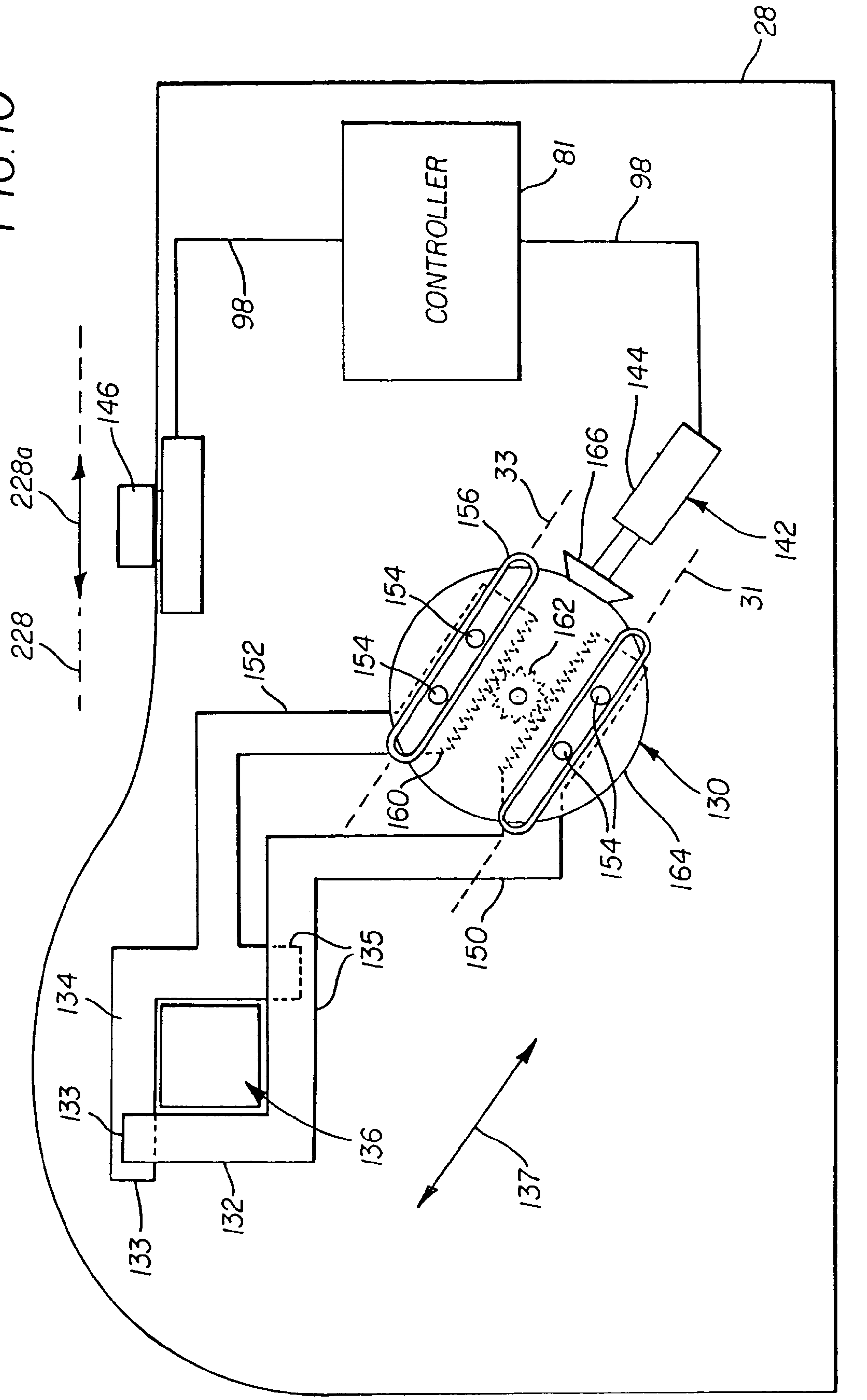
FIG. 9

FIG. 10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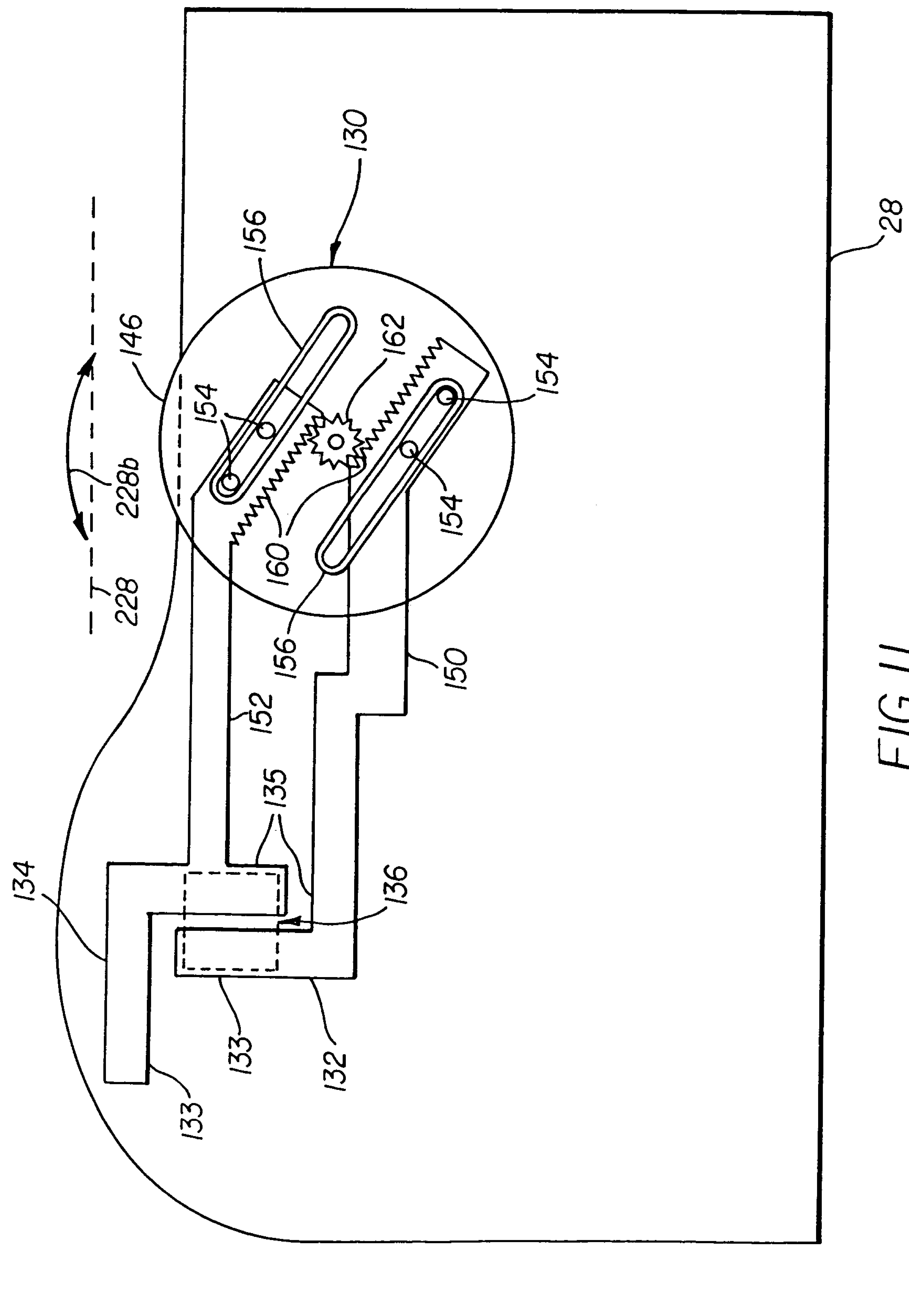
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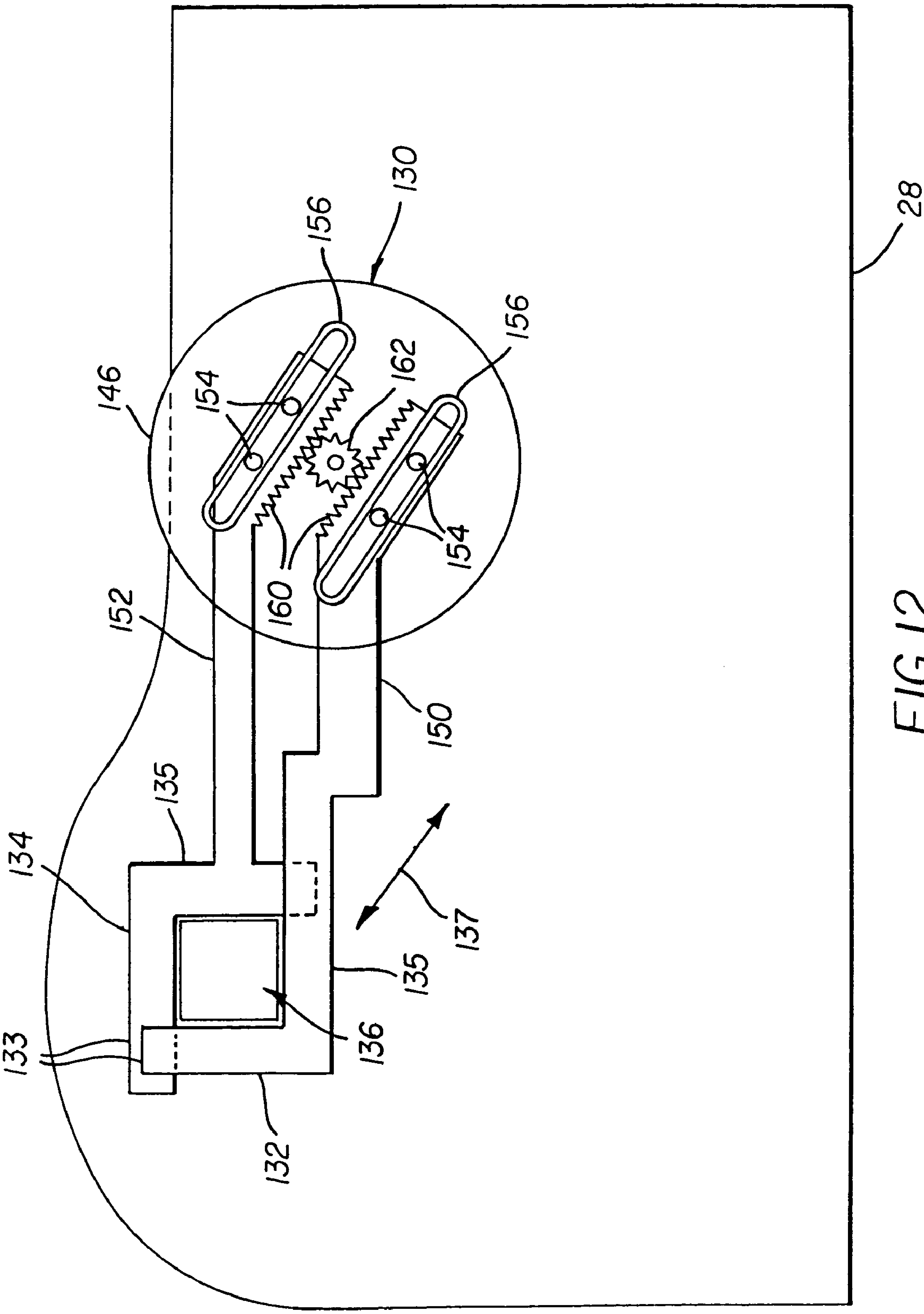
FIG. 11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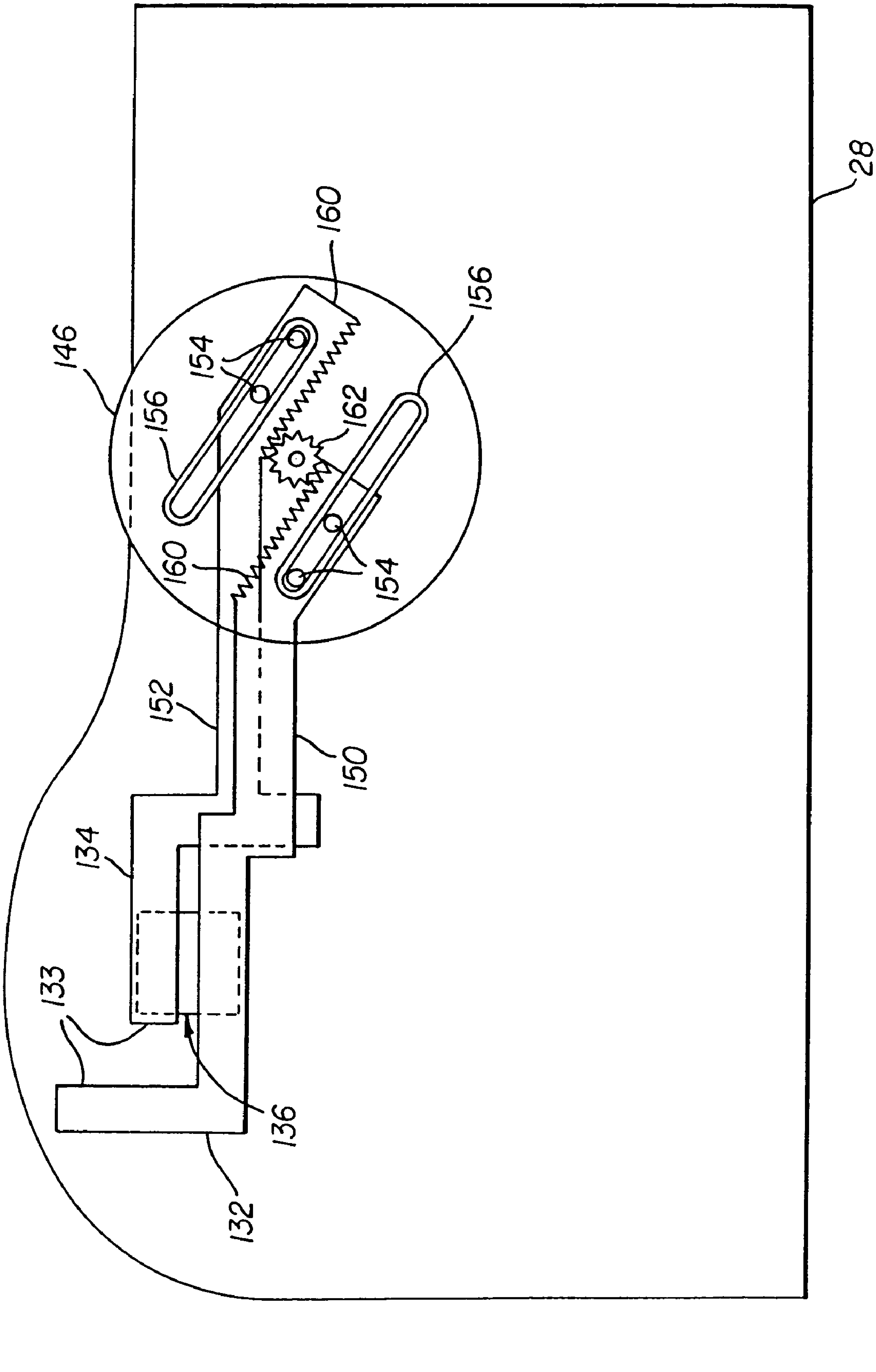


FIG. 13

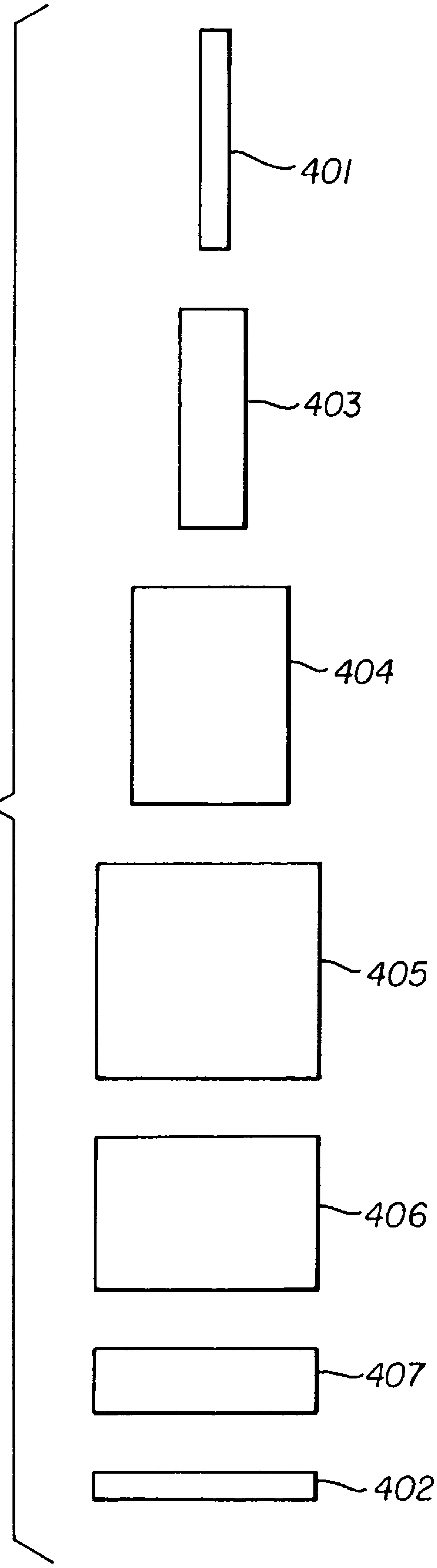


FIG. 14

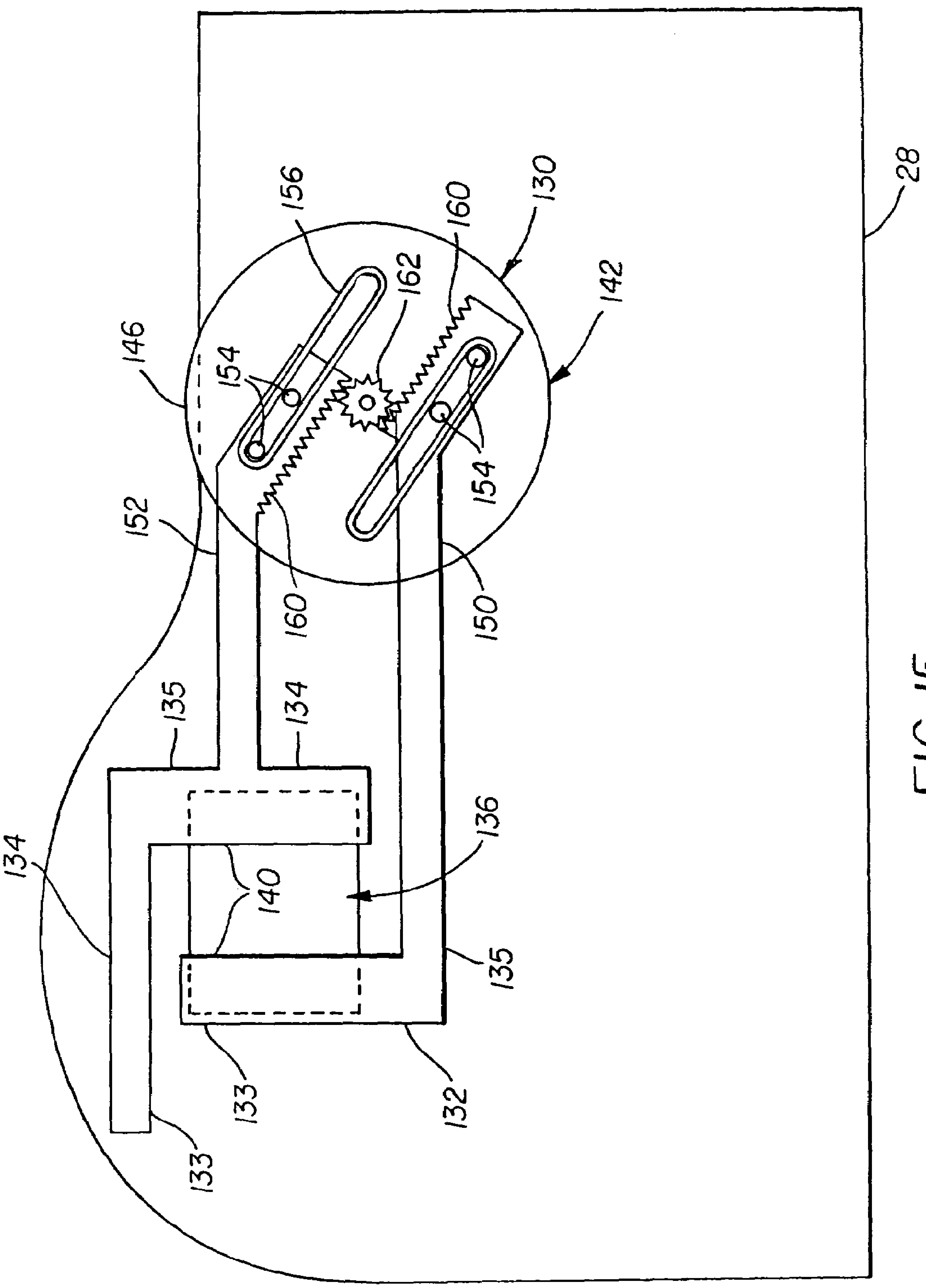
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FIG. 15

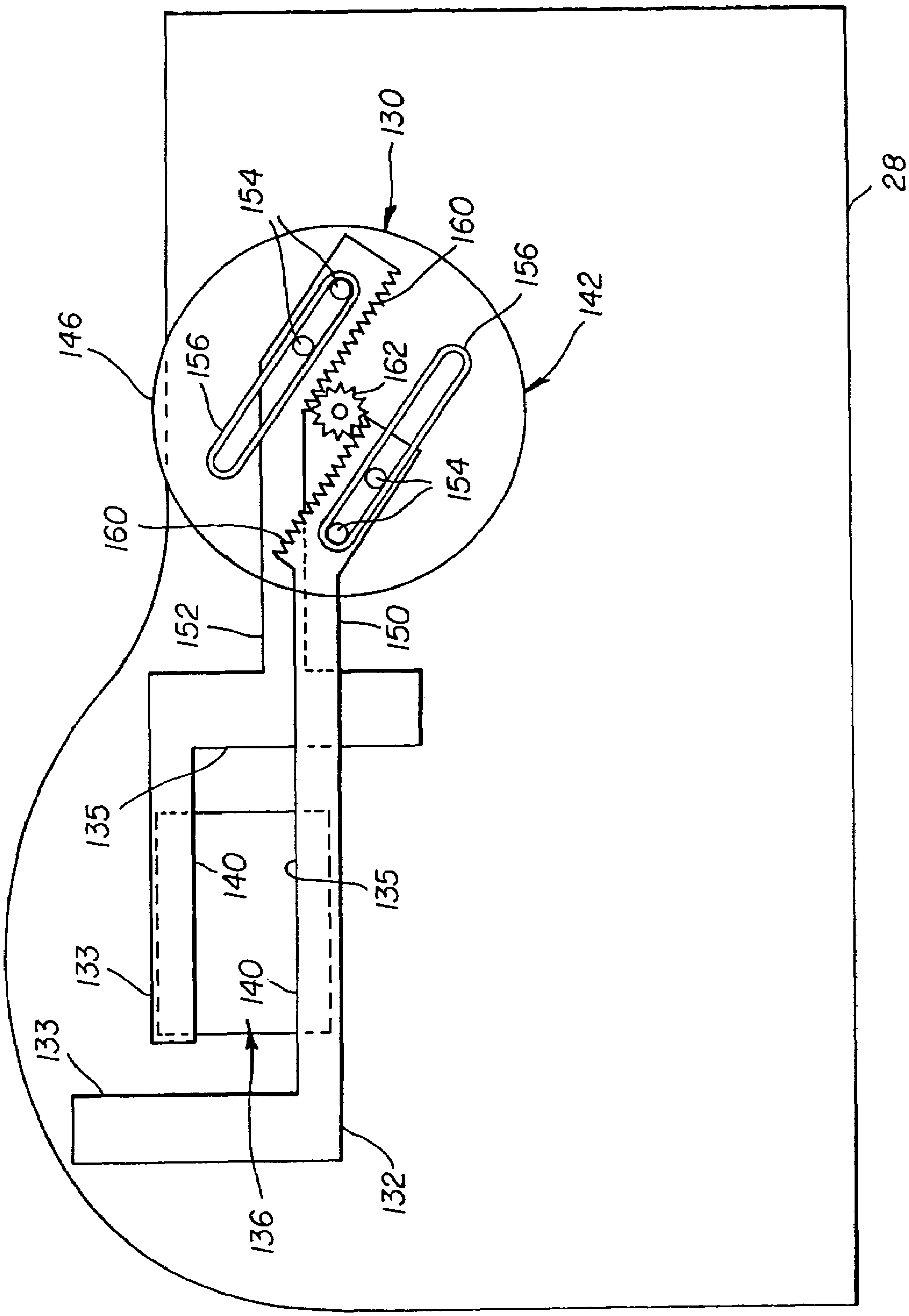
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FIG. 16

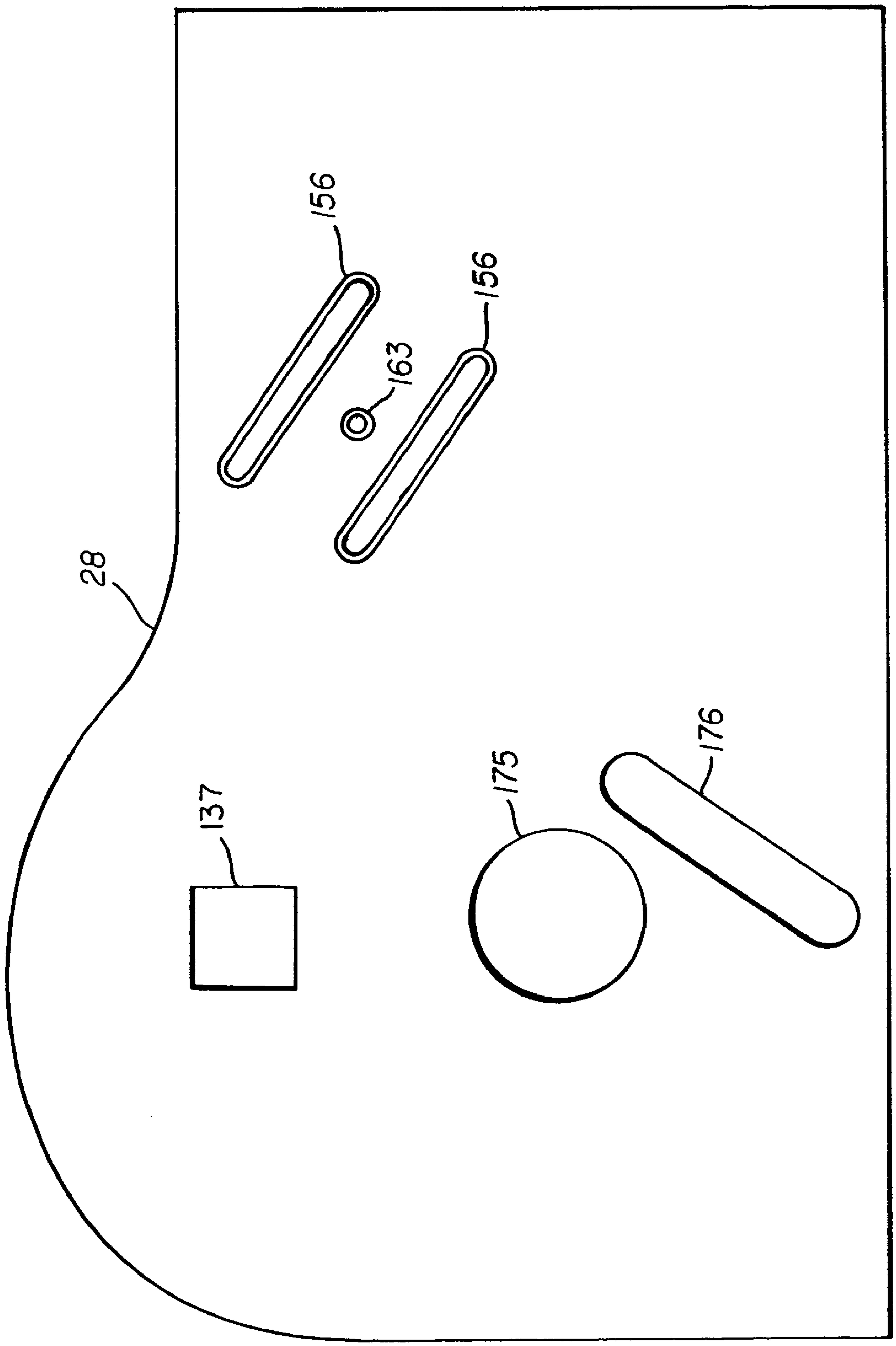


FIG. 17

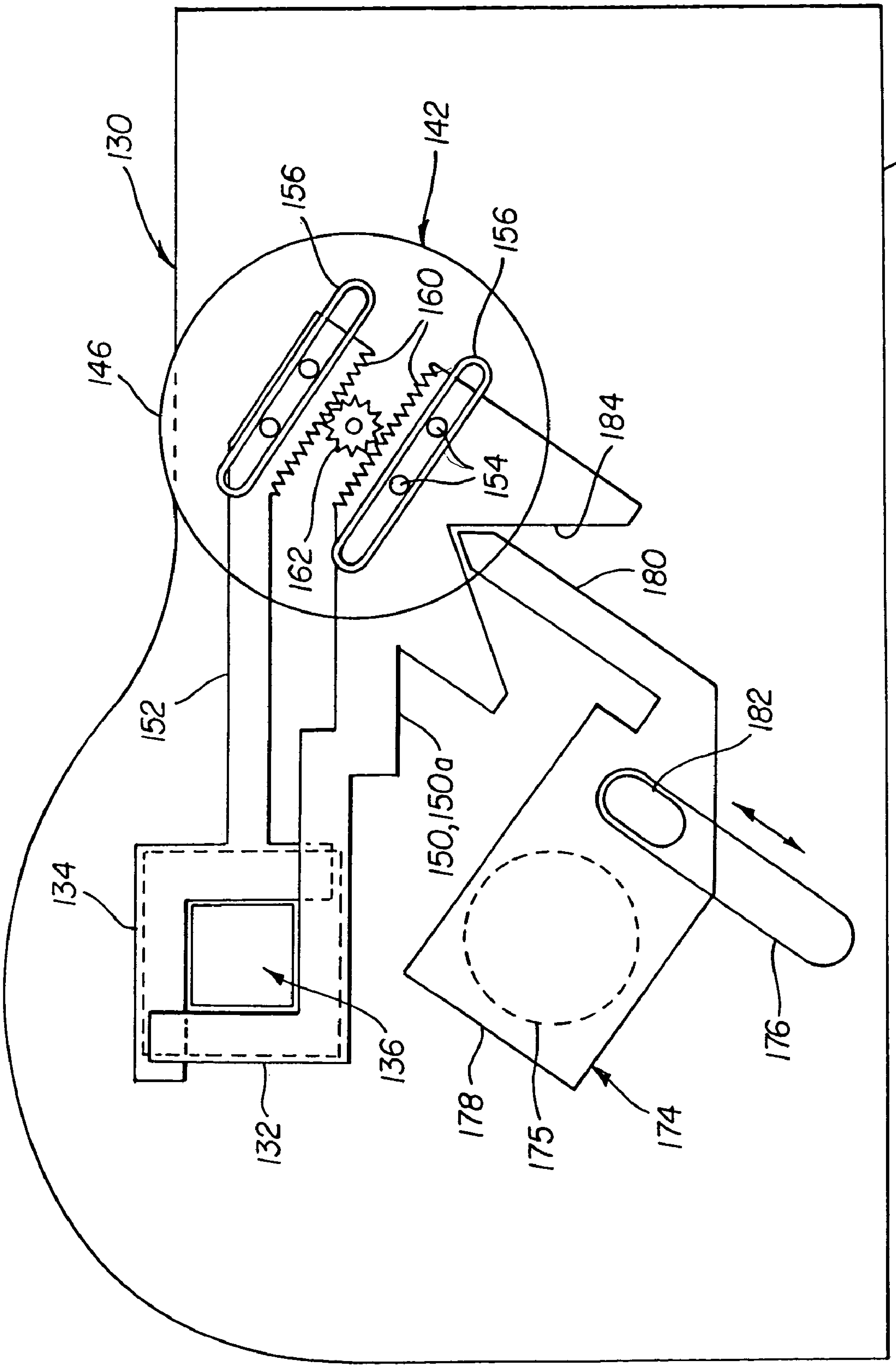
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FIG.18

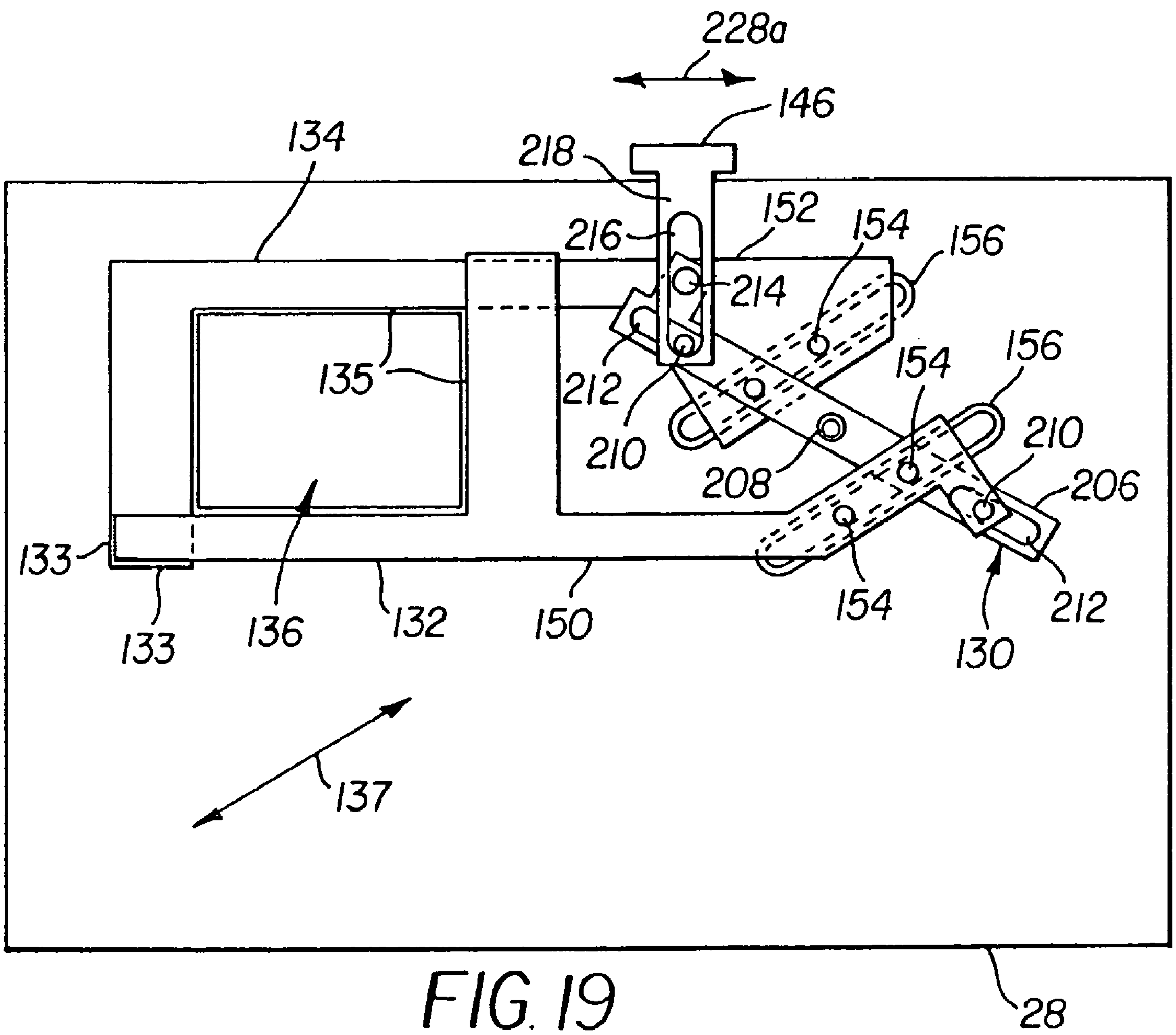
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FIG. 19

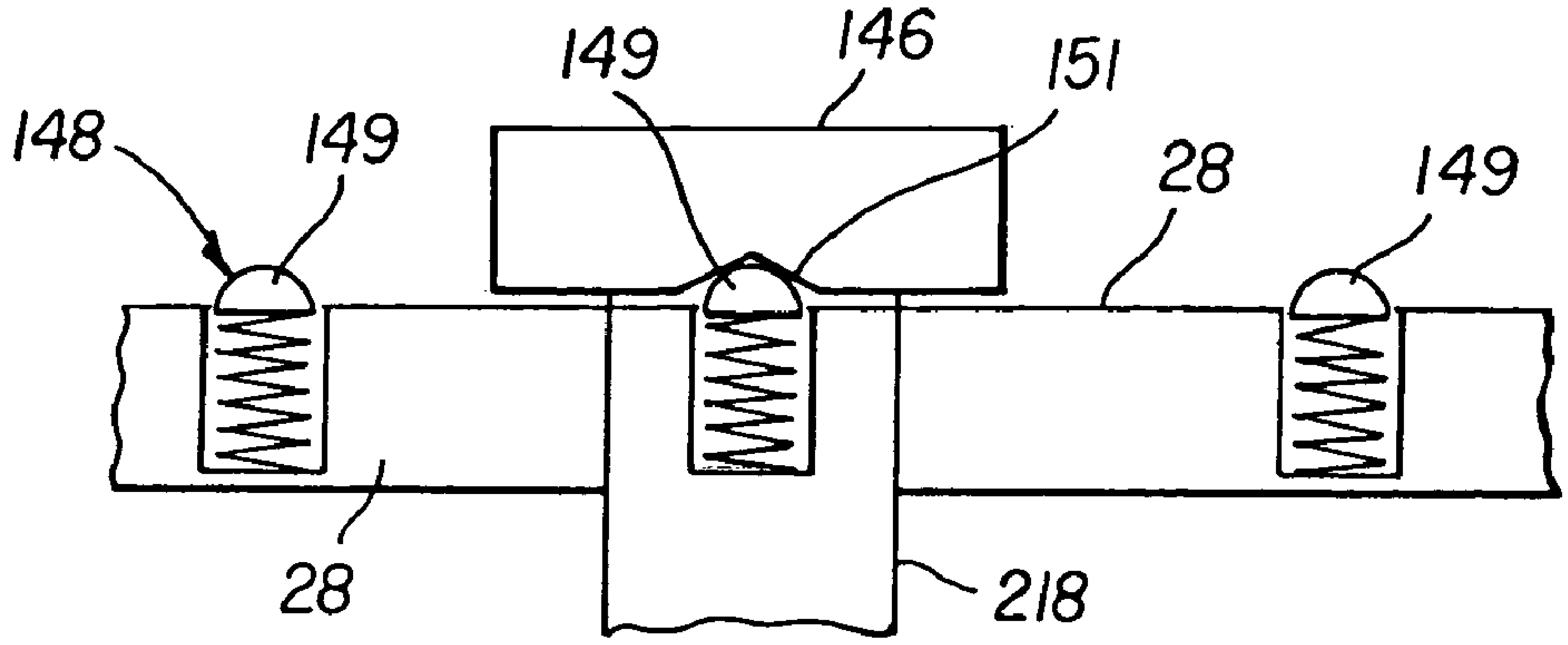
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FIG. 20

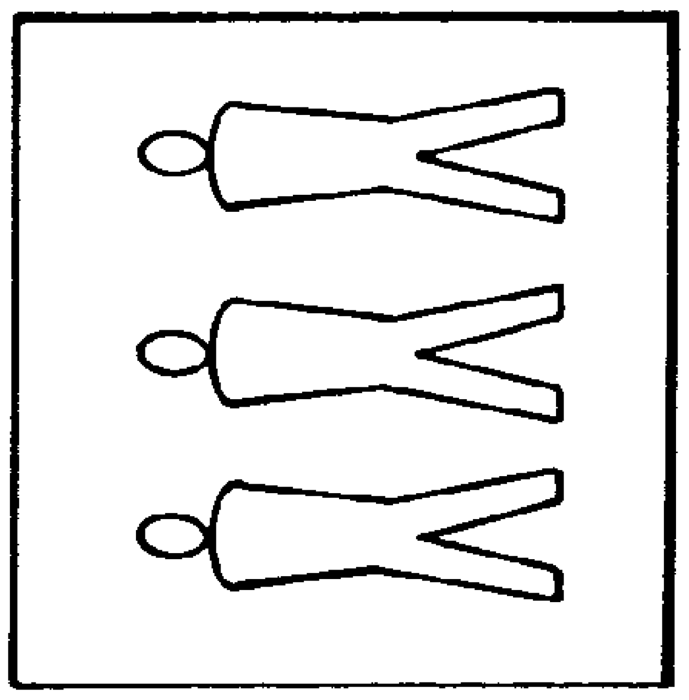


FIG. 21b

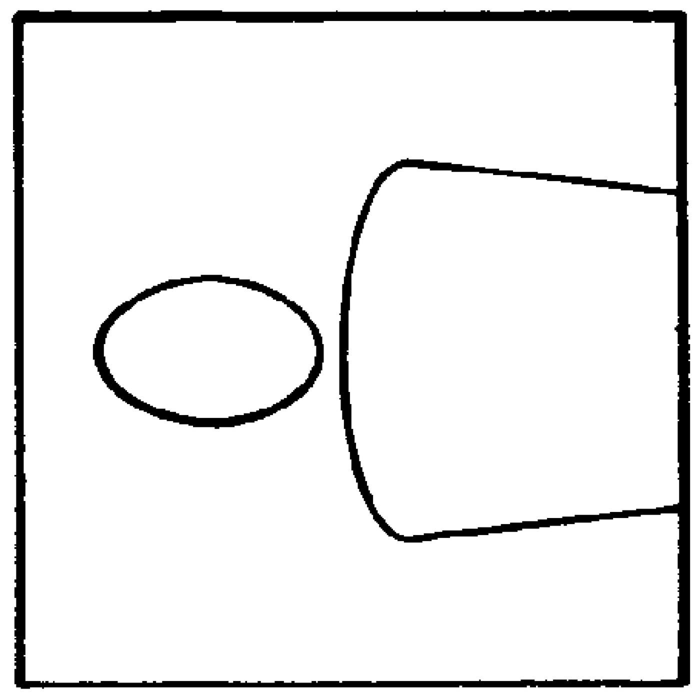


FIG. 22b

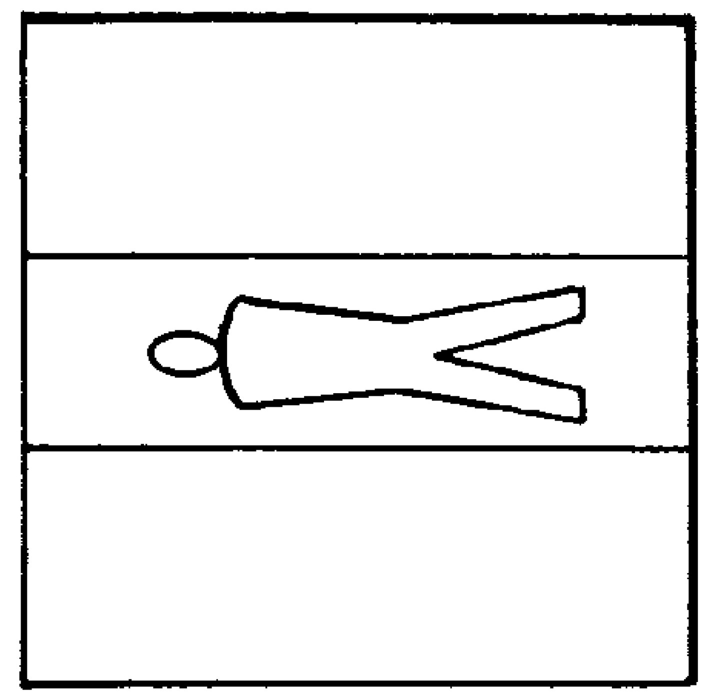


FIG. 23b

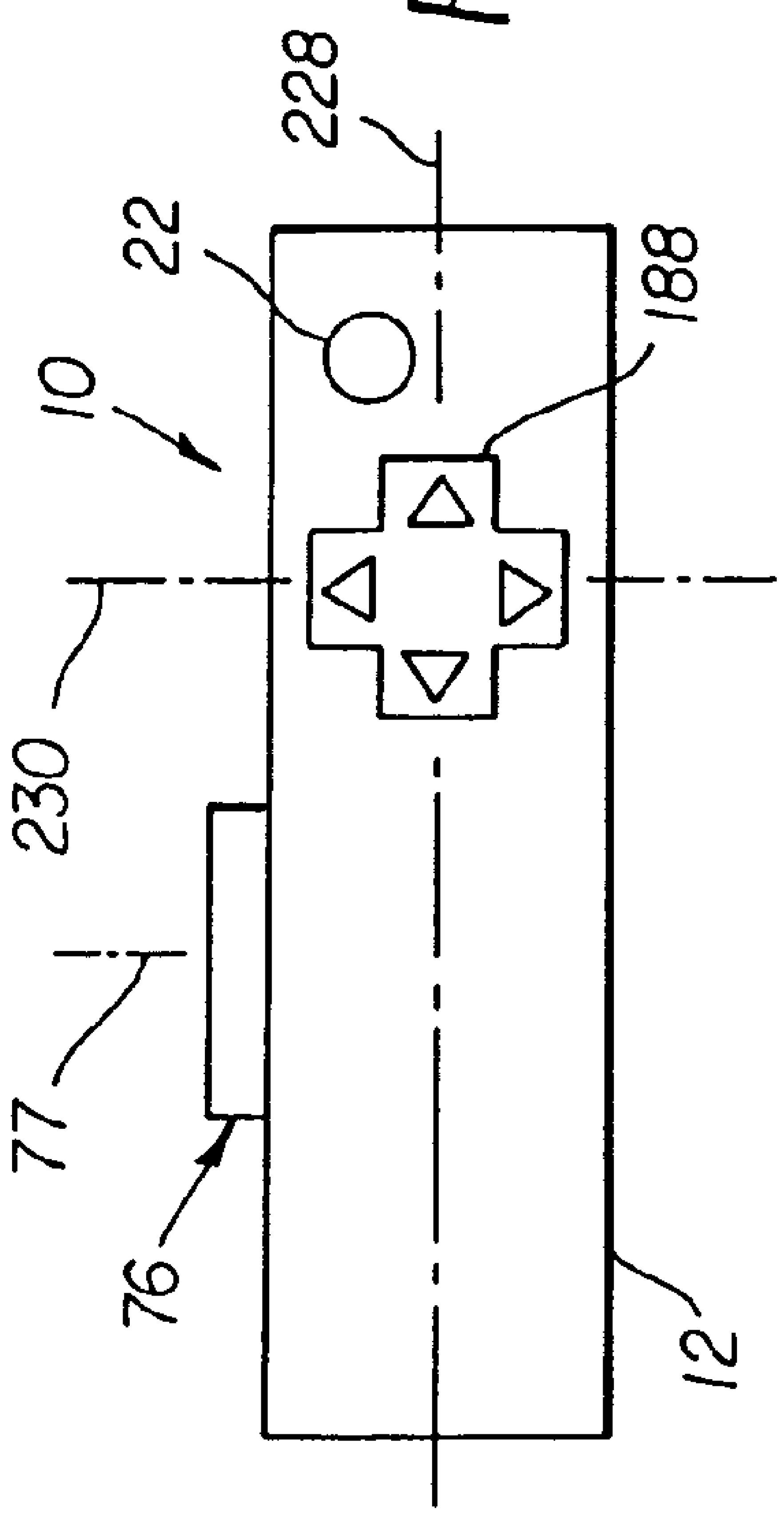



FIG. 21a

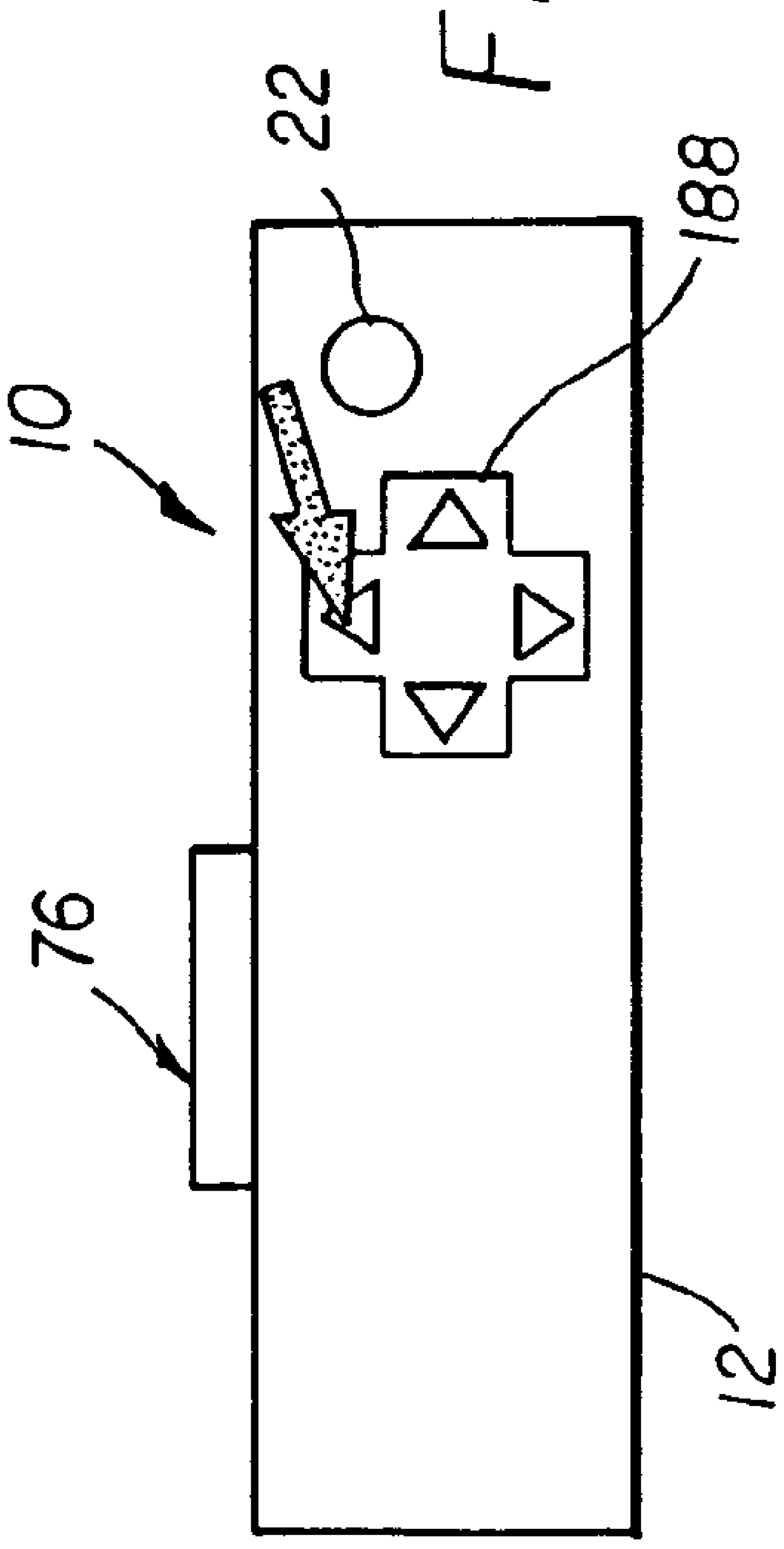



FIG. 22a

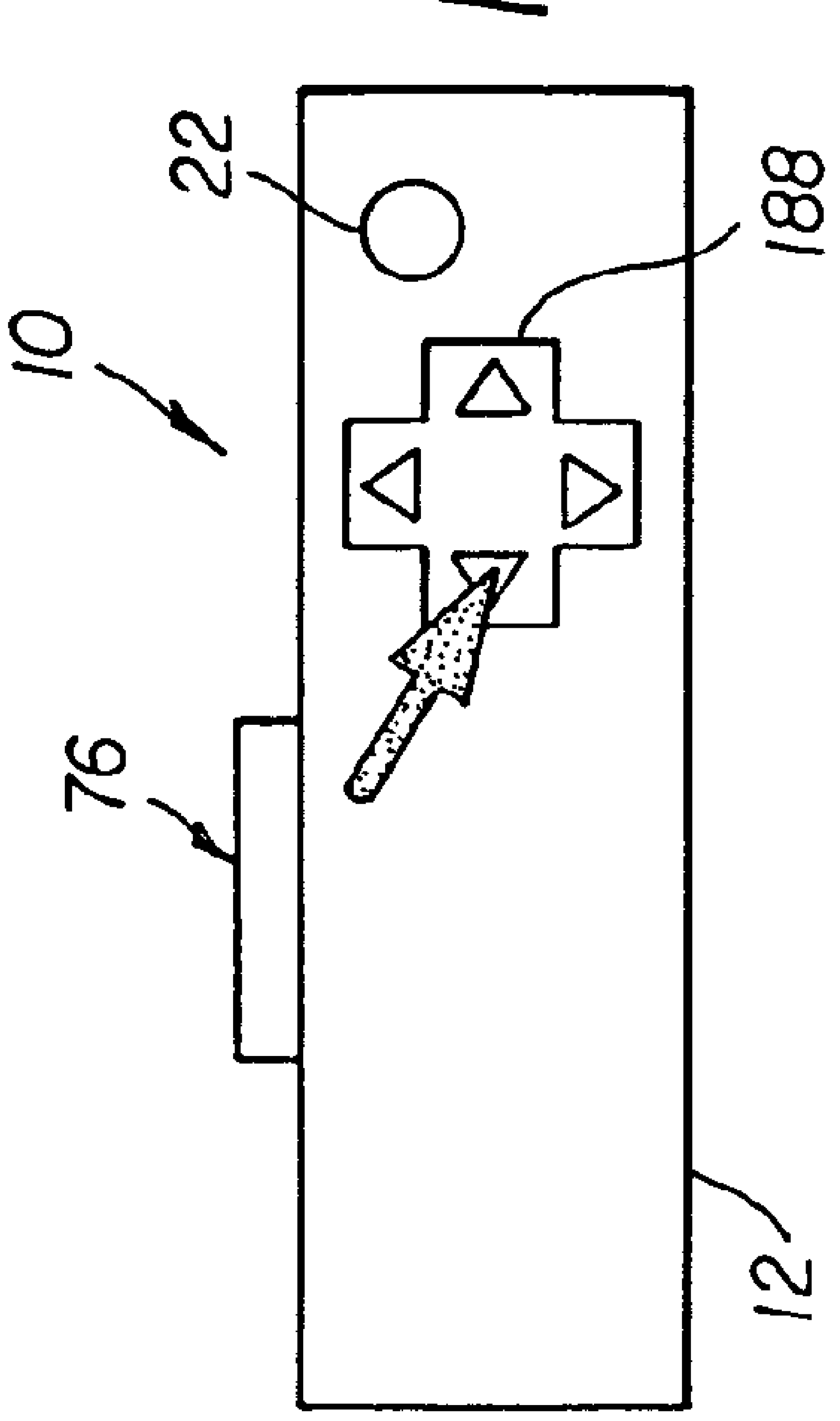
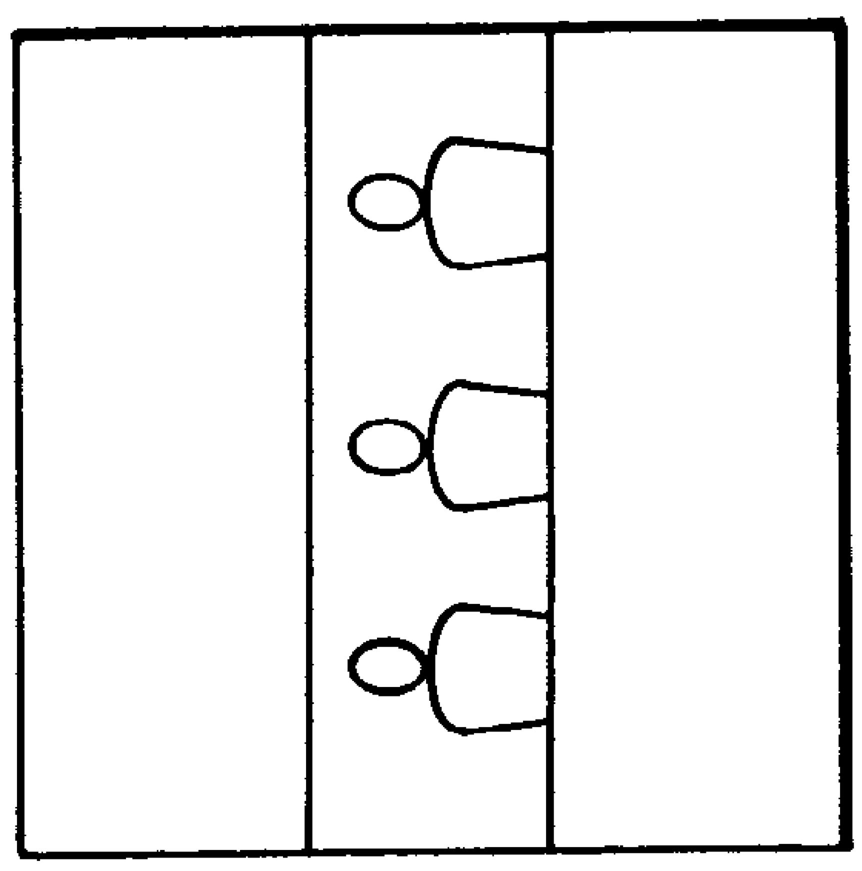



FIG. 23a



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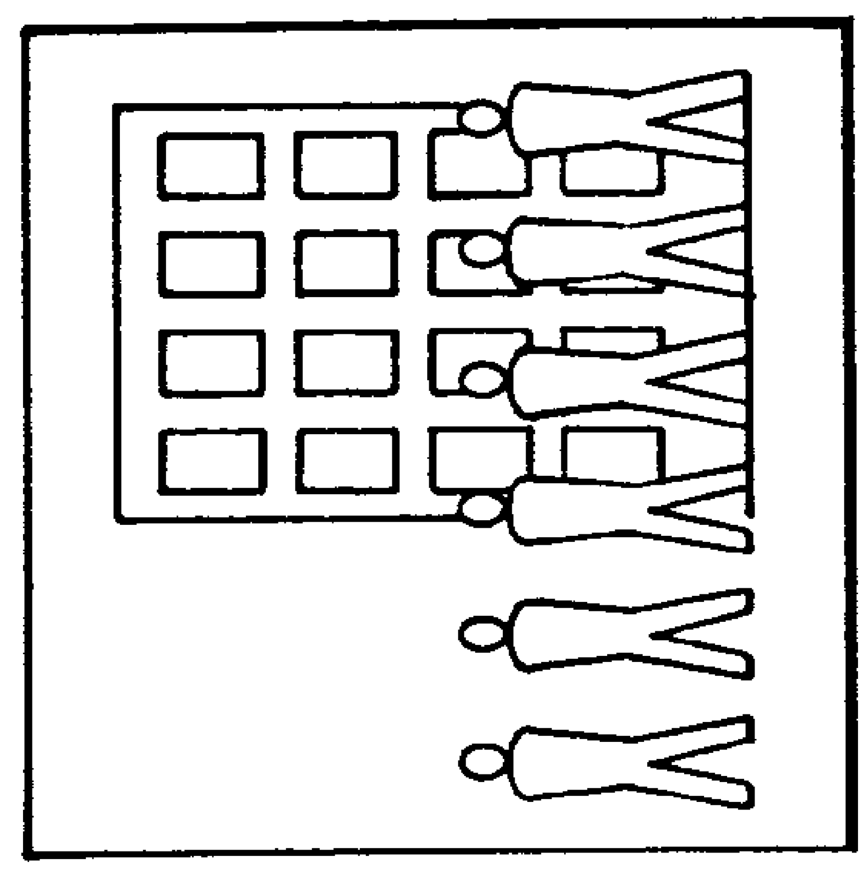

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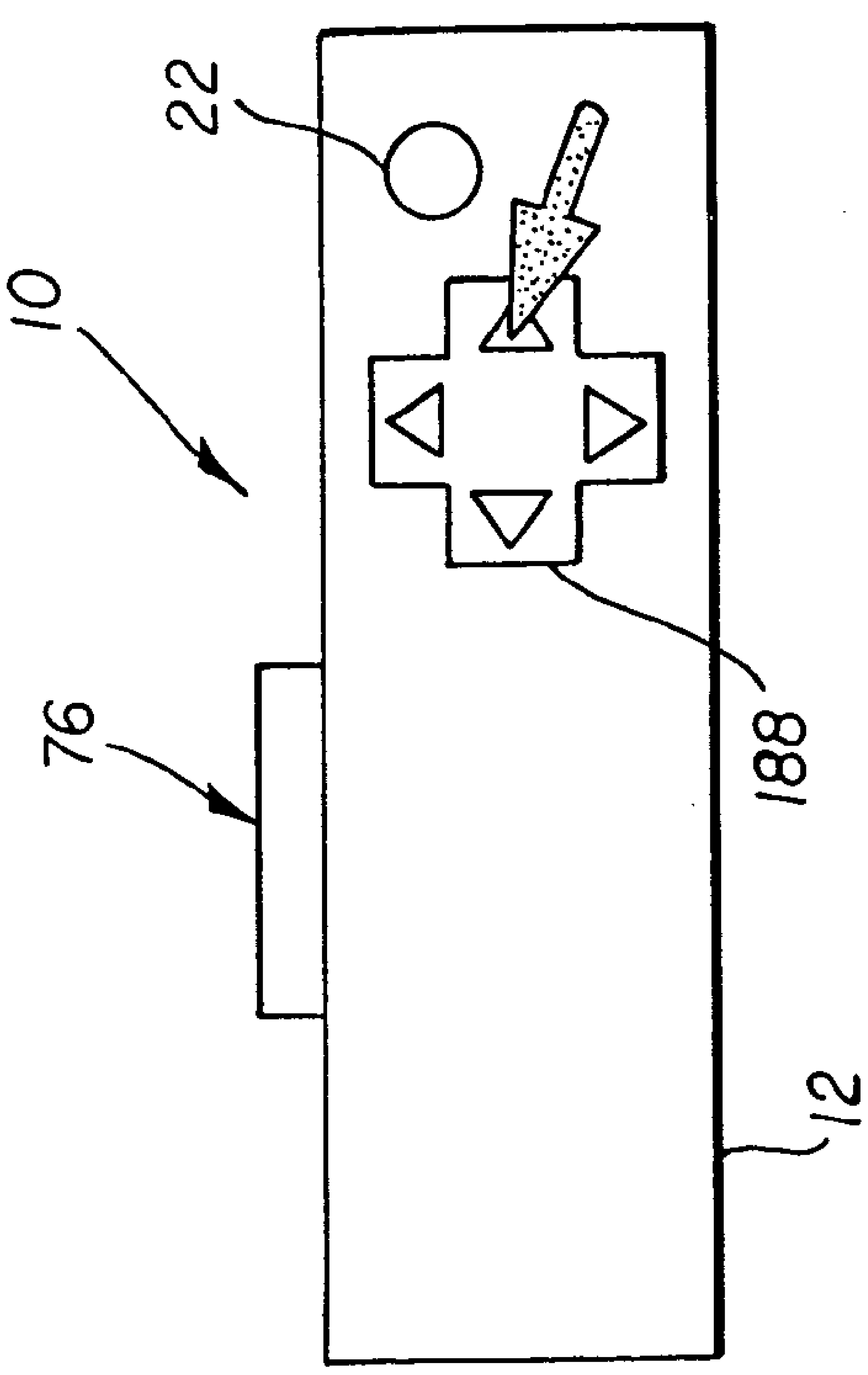



FIG. 24a

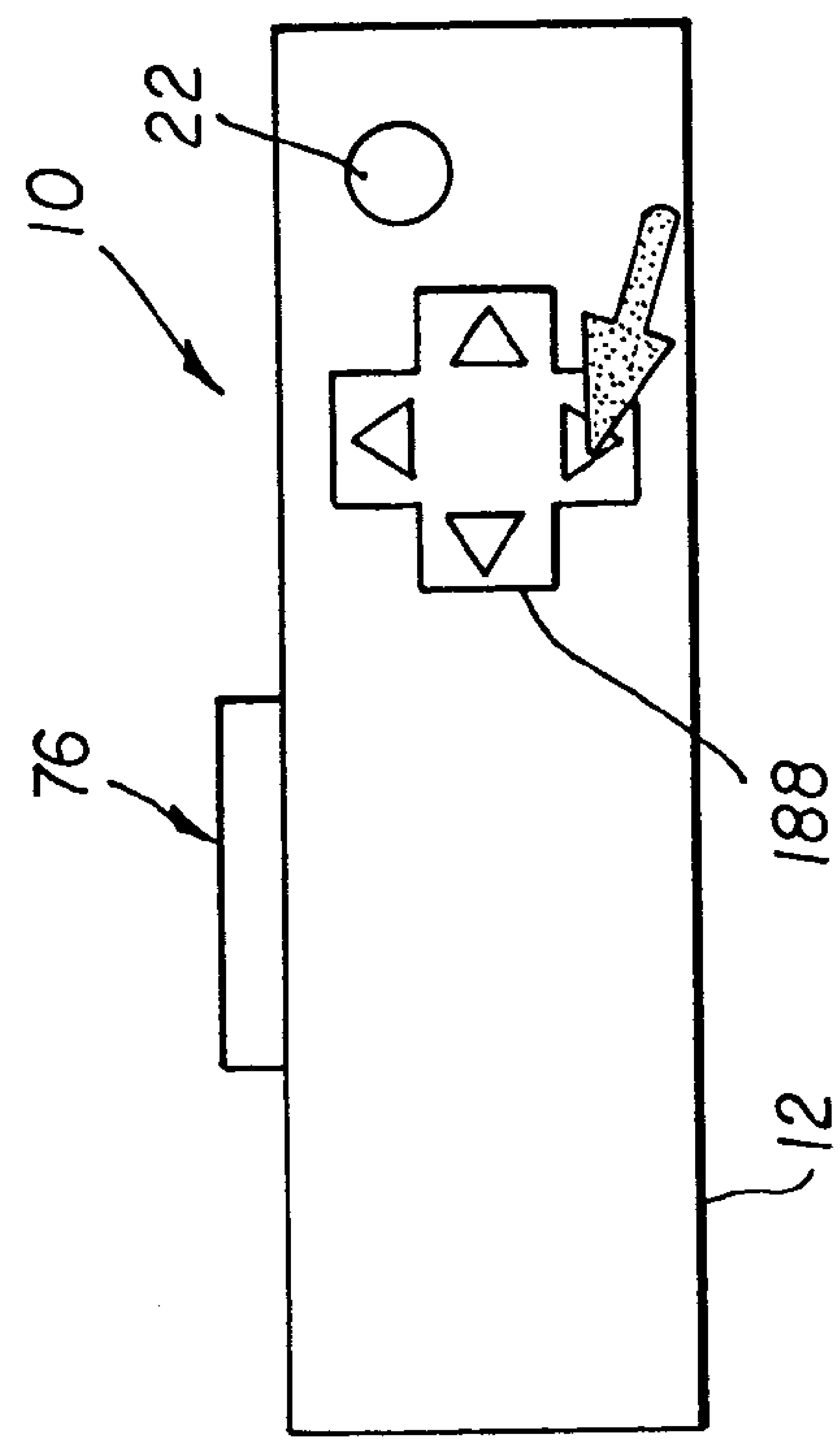
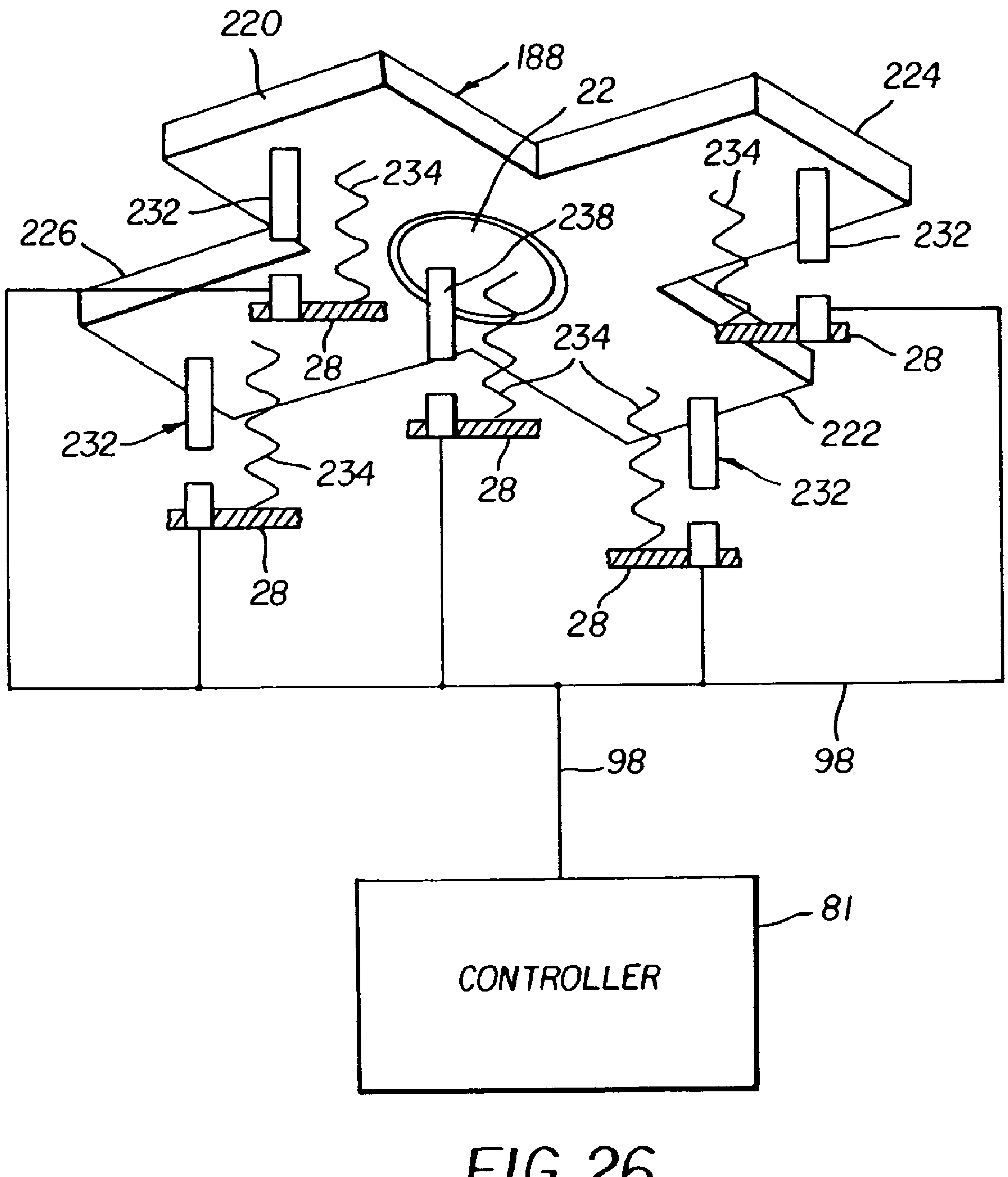



FIG. 25a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CONTROLLER
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FIG. 26

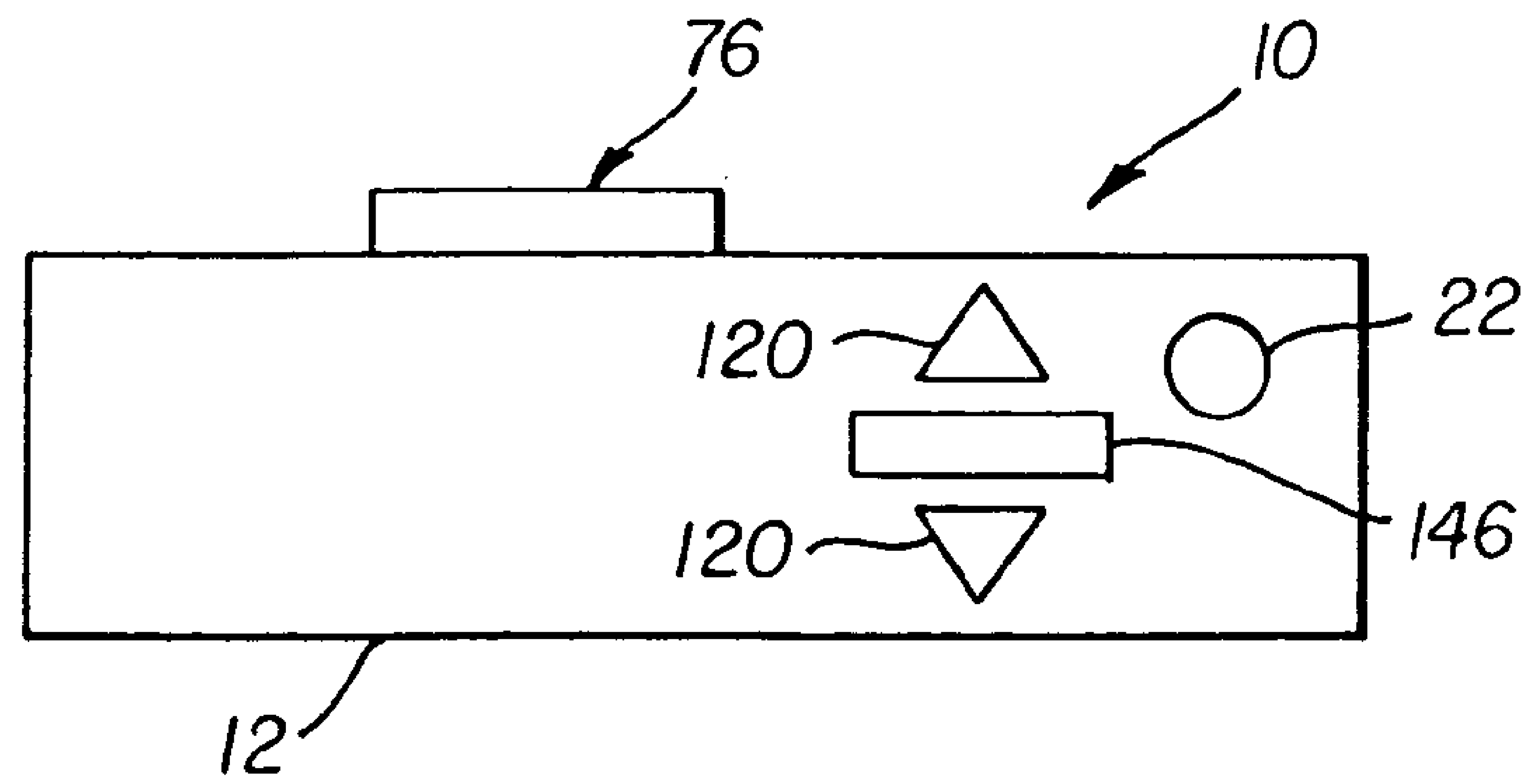


FIG. 27a

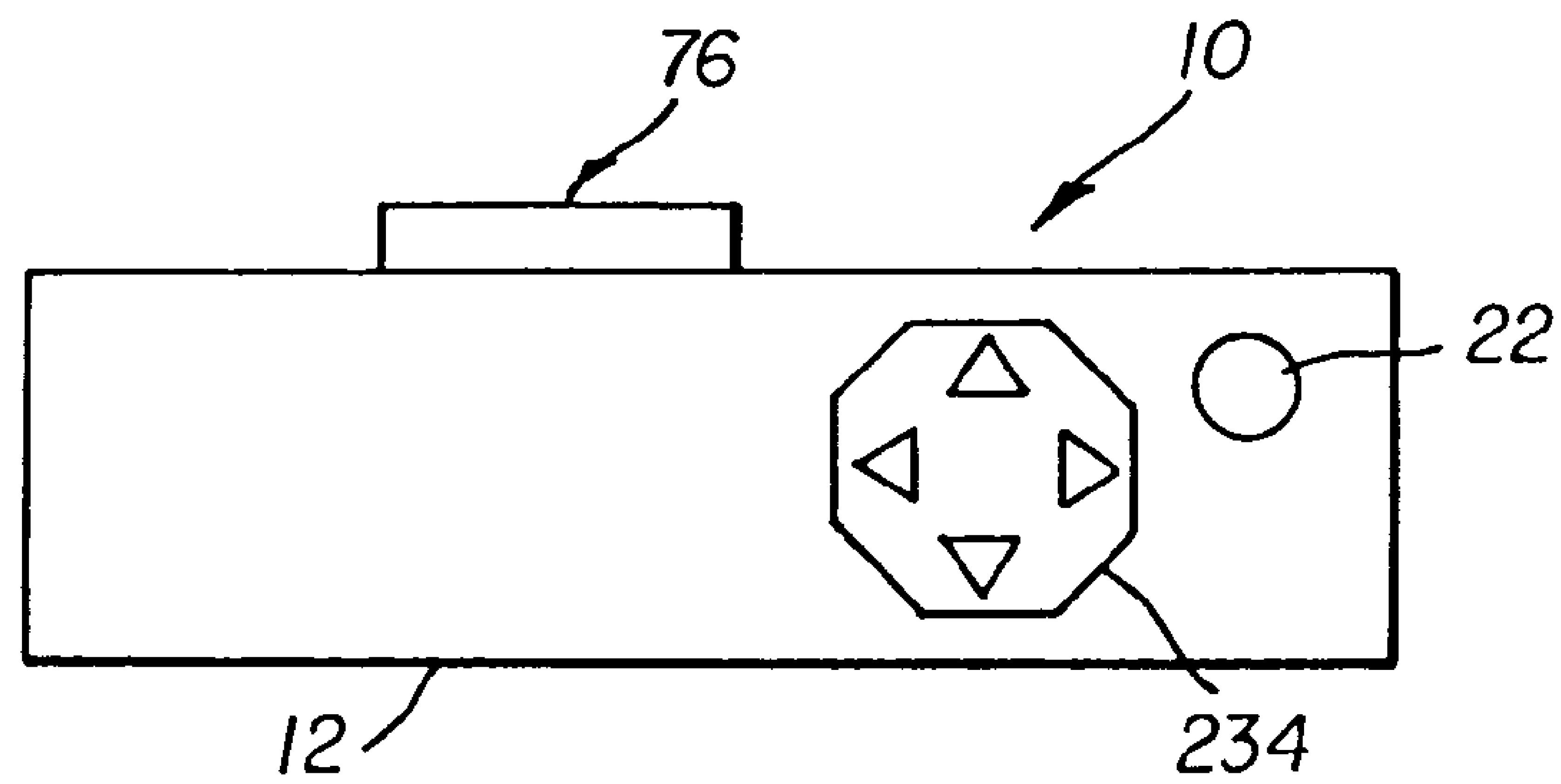


FIG. 27b

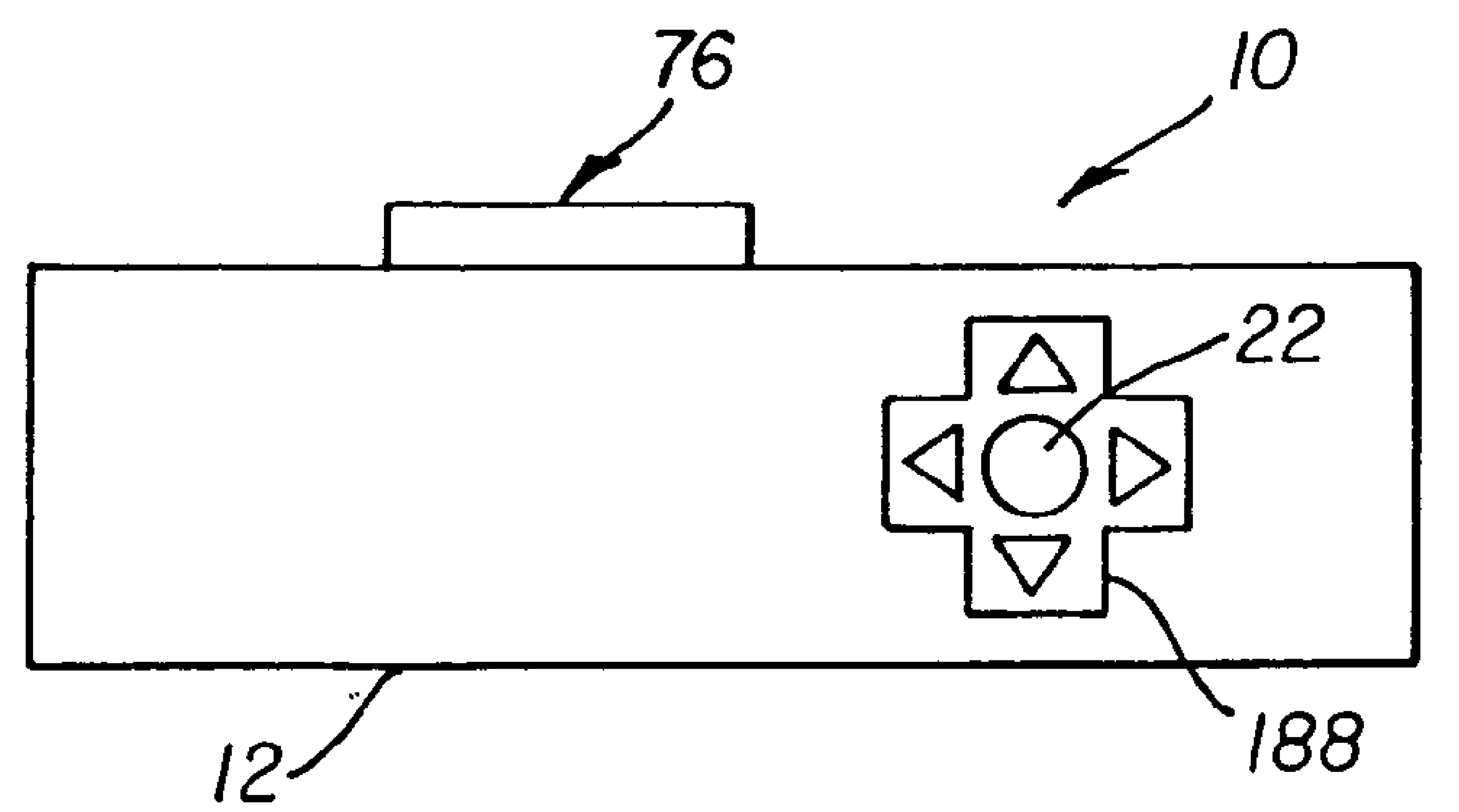


FIG. 27c

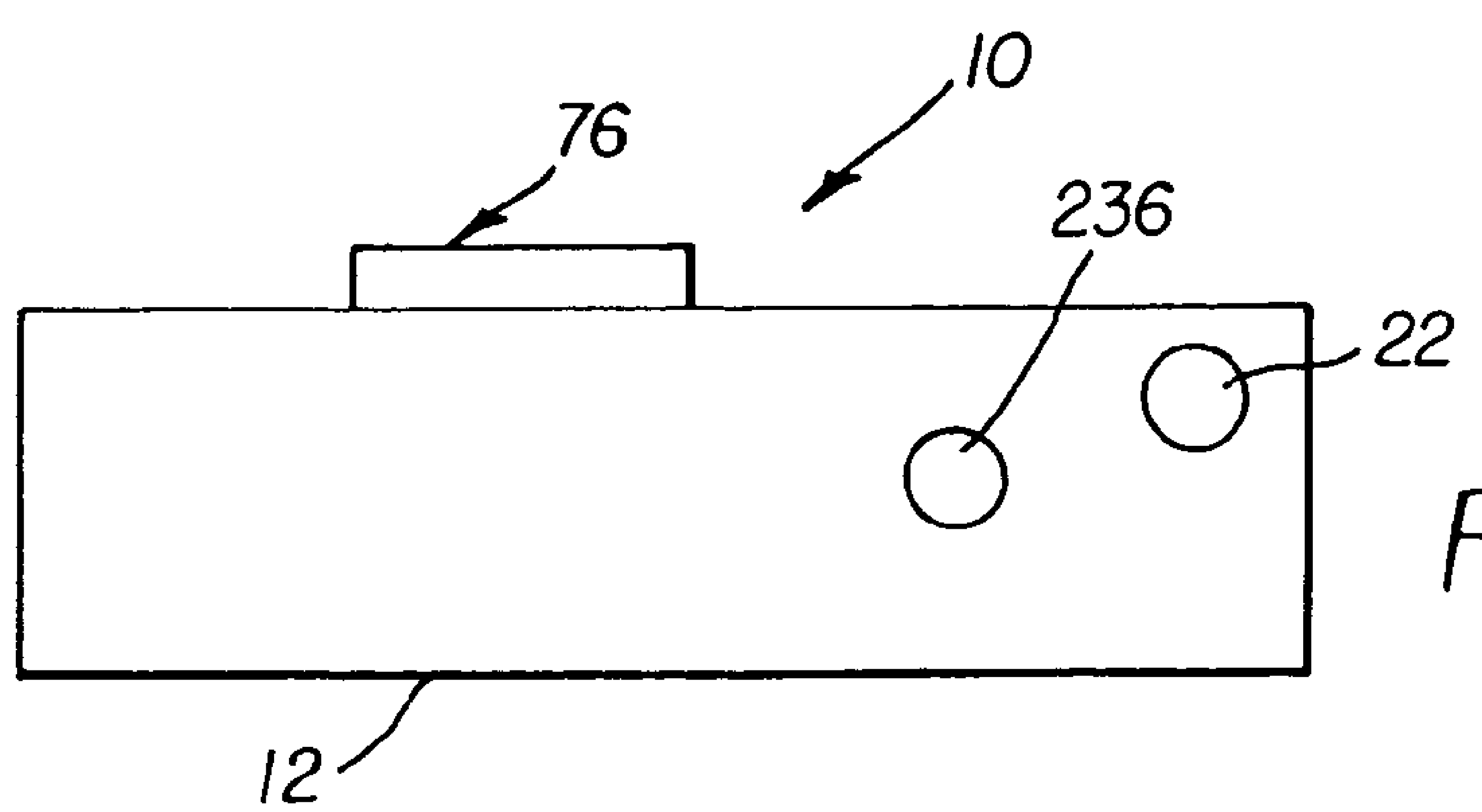


FIG. 27d

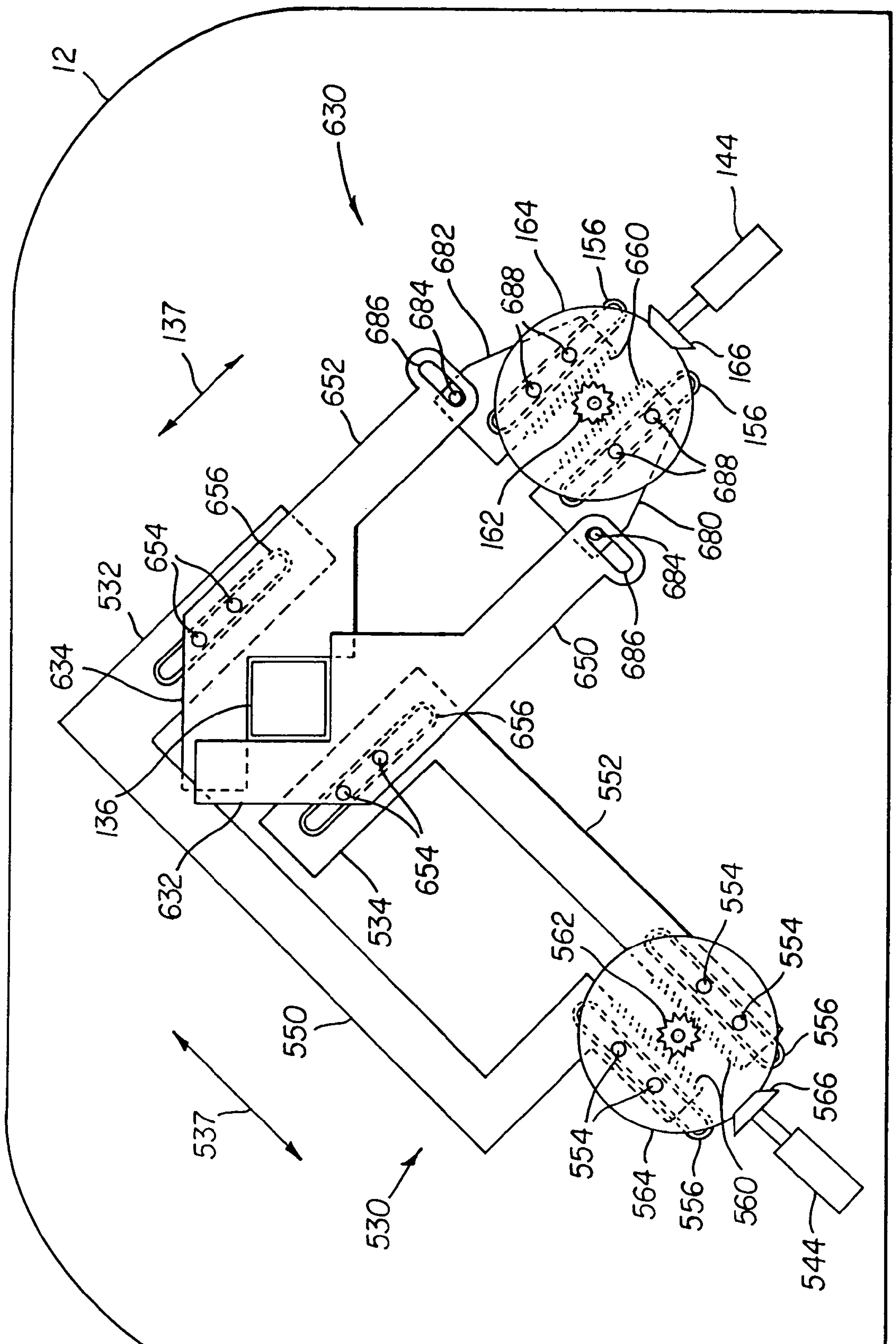
12
630
137
144
164
156
660
682
688
684
686
652
166
156
656
162
688
680
654
532
684
634
686
650
656
136
552
654
632
534
554
562
554
550
556
537
554
566
564
556
560
530
544

FIG. 28

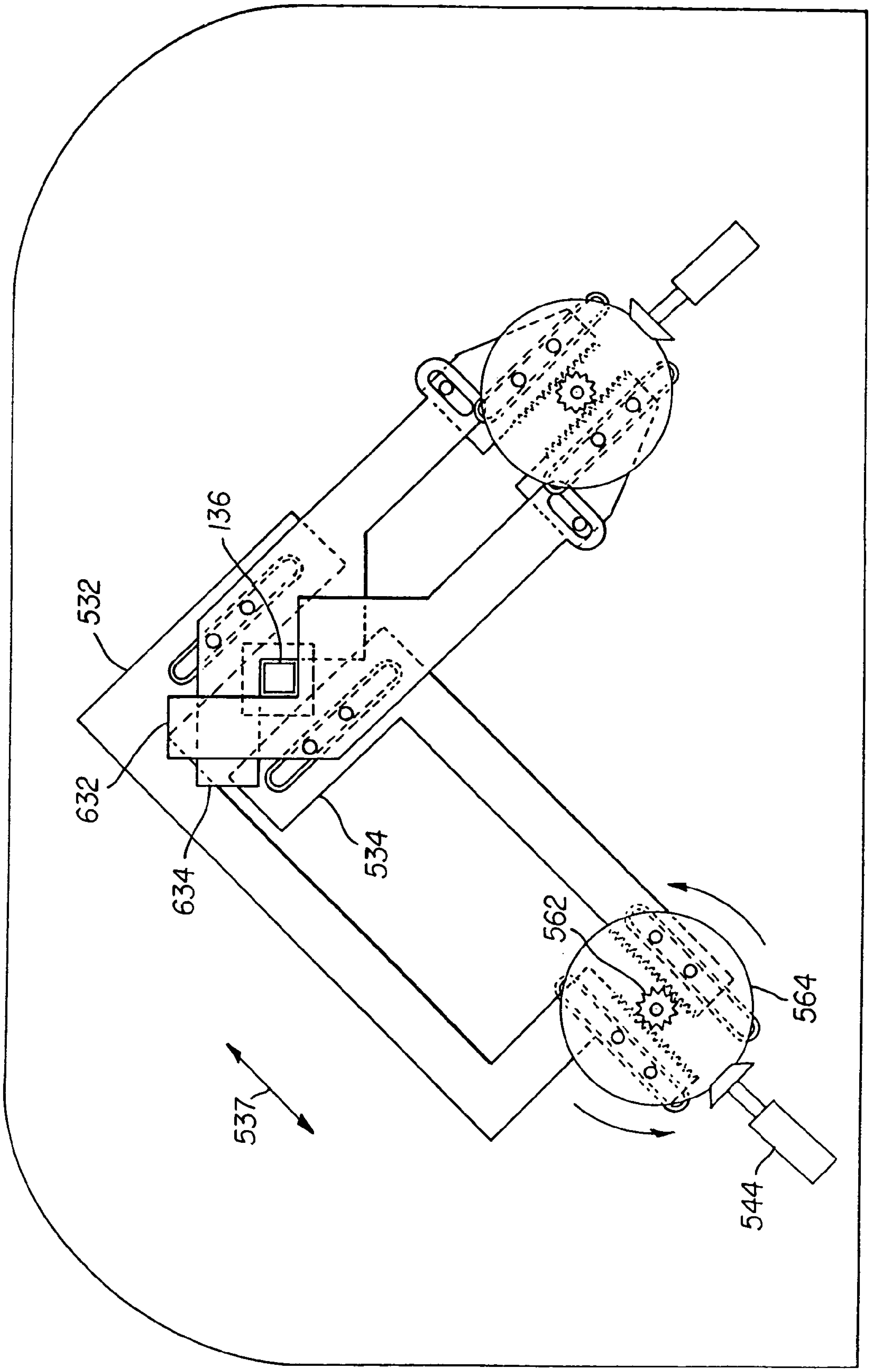


FIG. 29

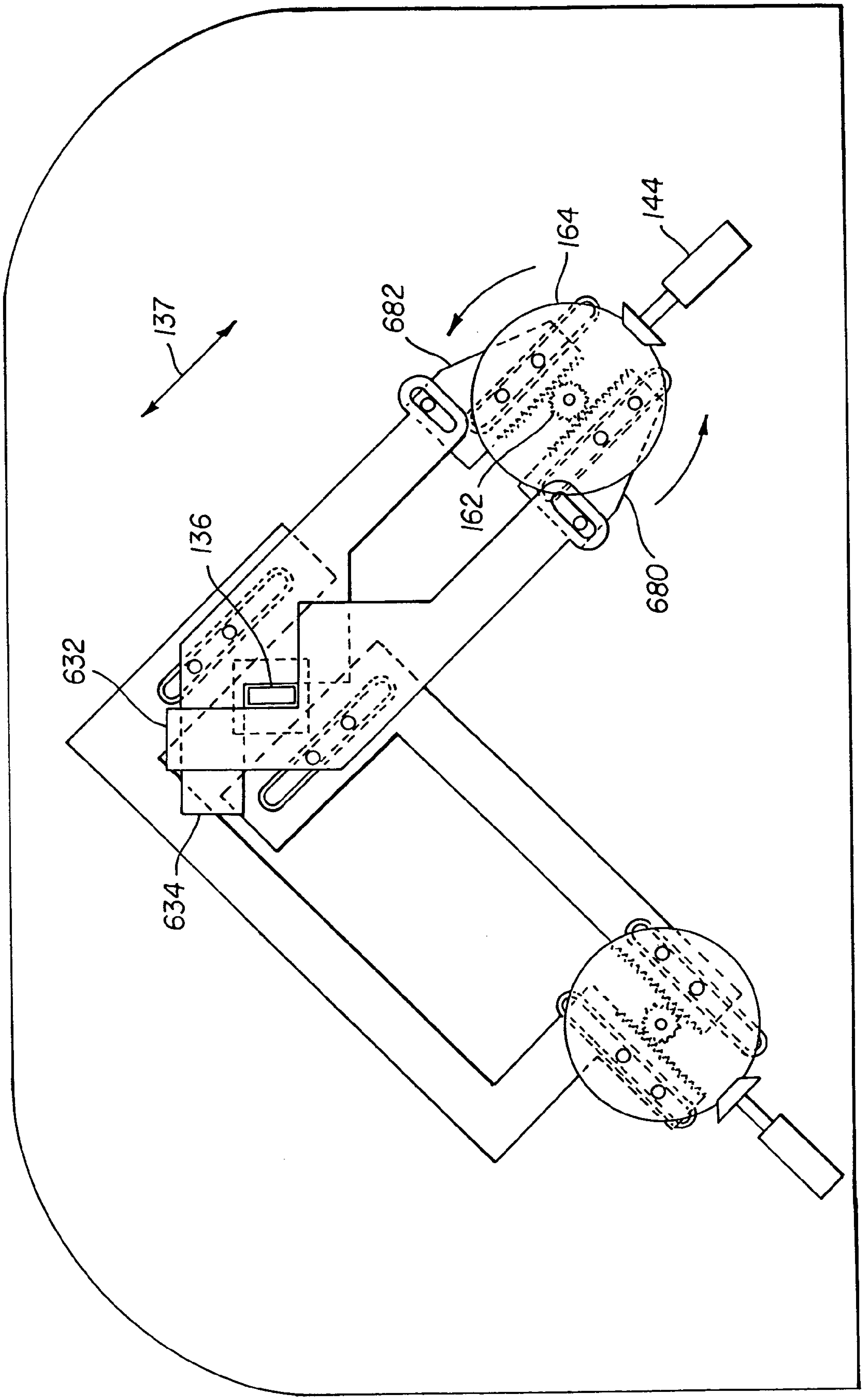


FIG. 30

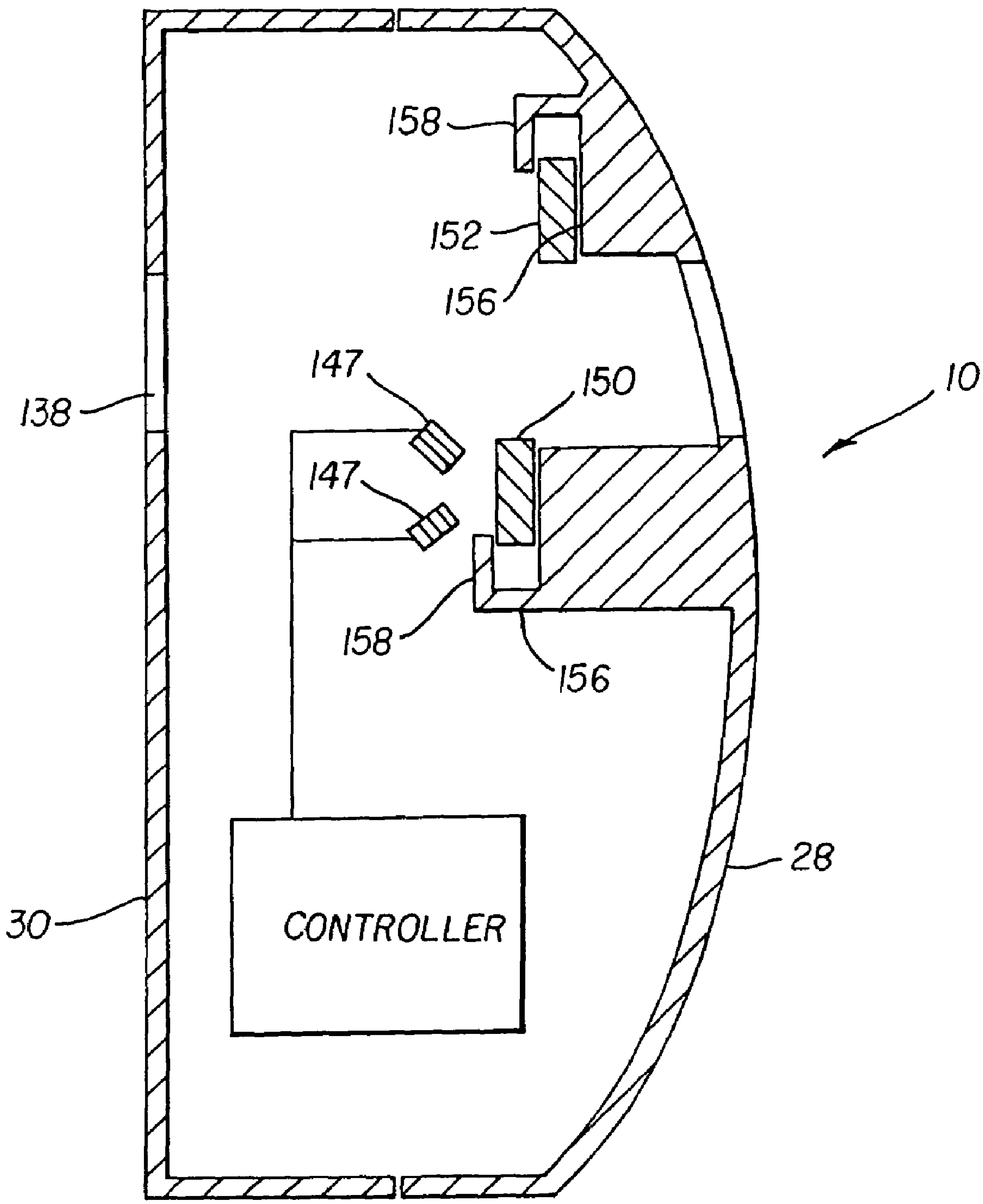


FIG. 31

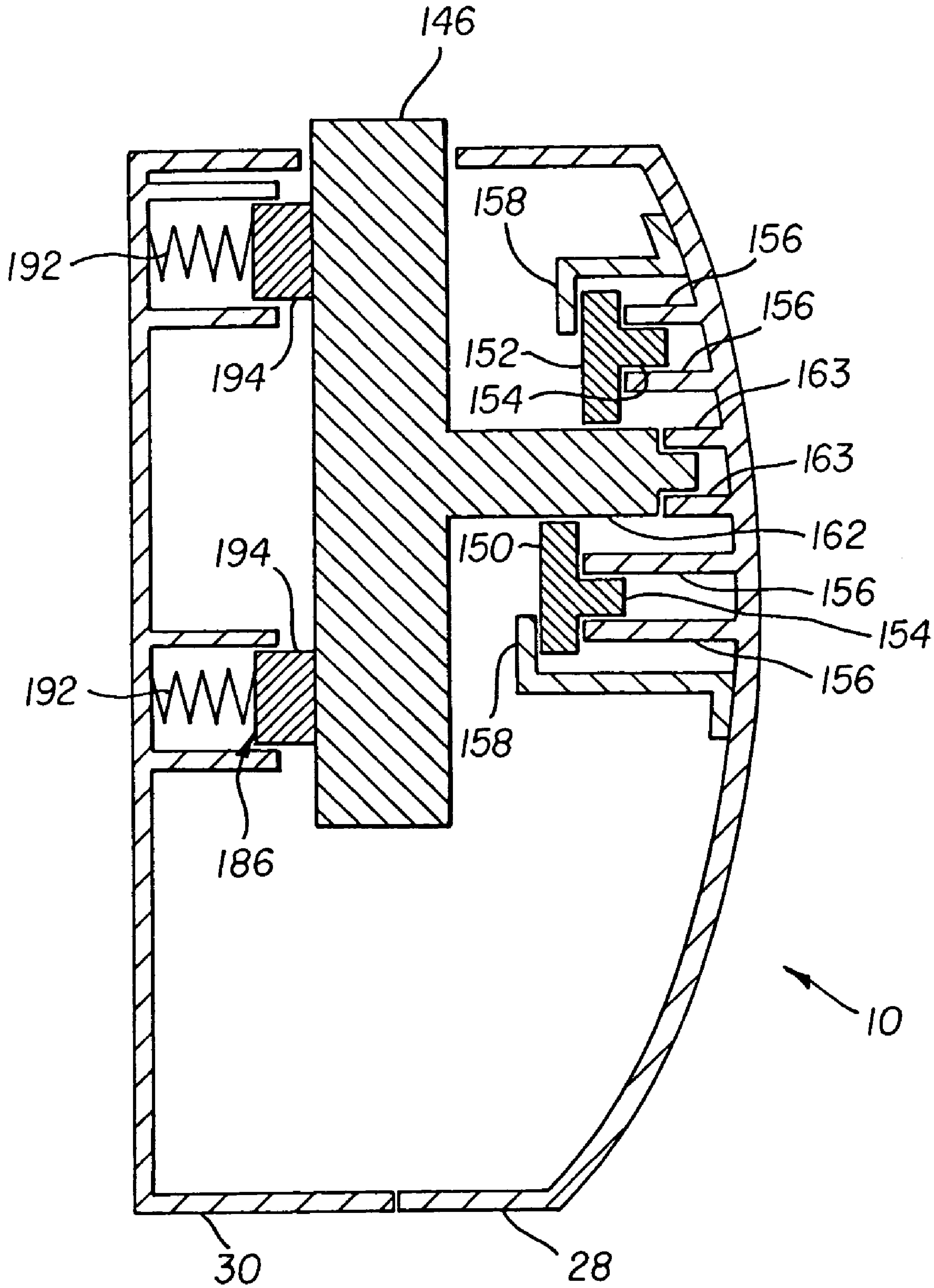
146
158
156
156
192
152
154
163
194
163
162
194
150
156
154
192
156
158
186
10
30
28

FIG. 32

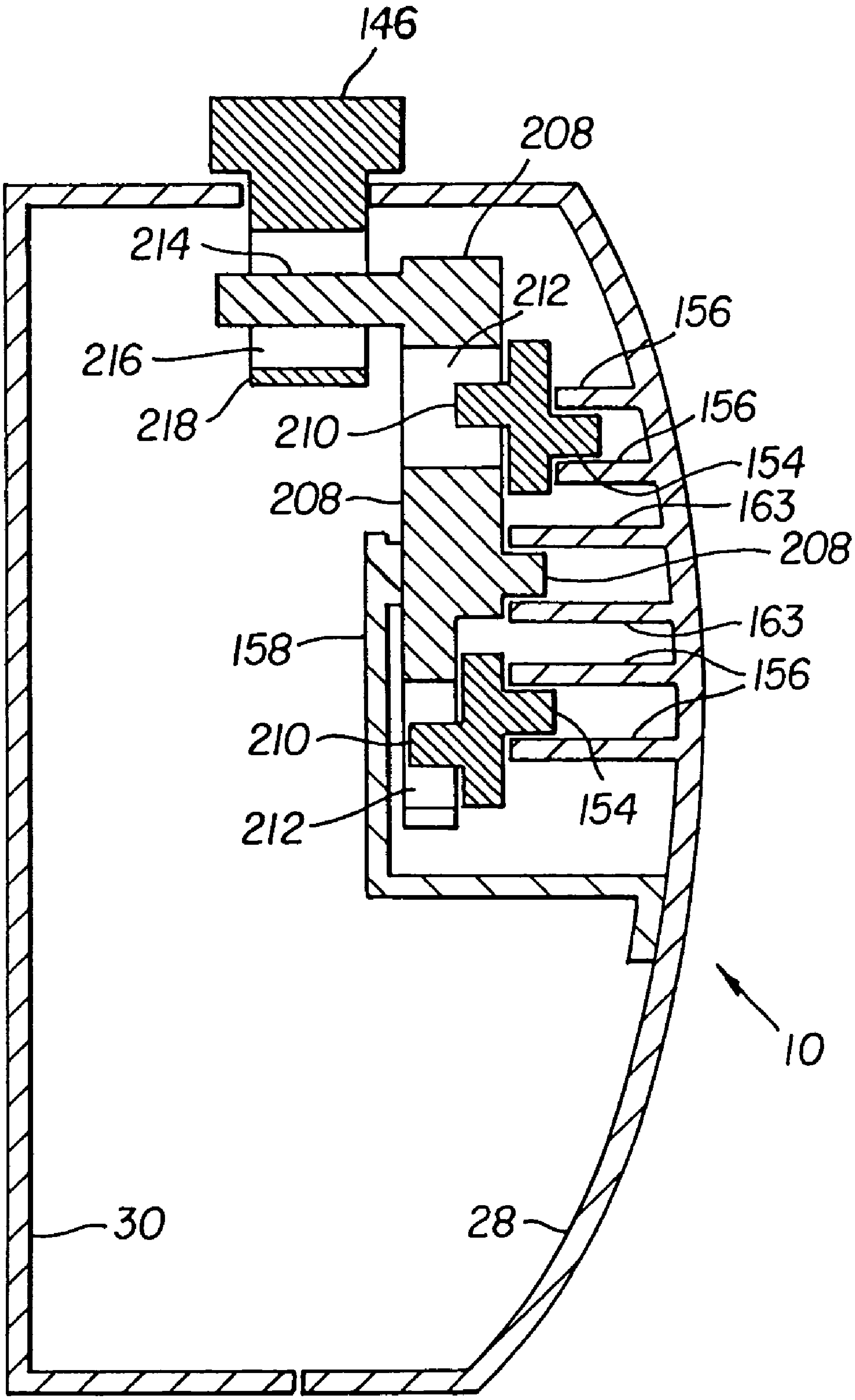
146
208
214
212
156
216
156
218
210
154
208
163
208
163
158
156
210
154
212
10
30
28

FIG. 33

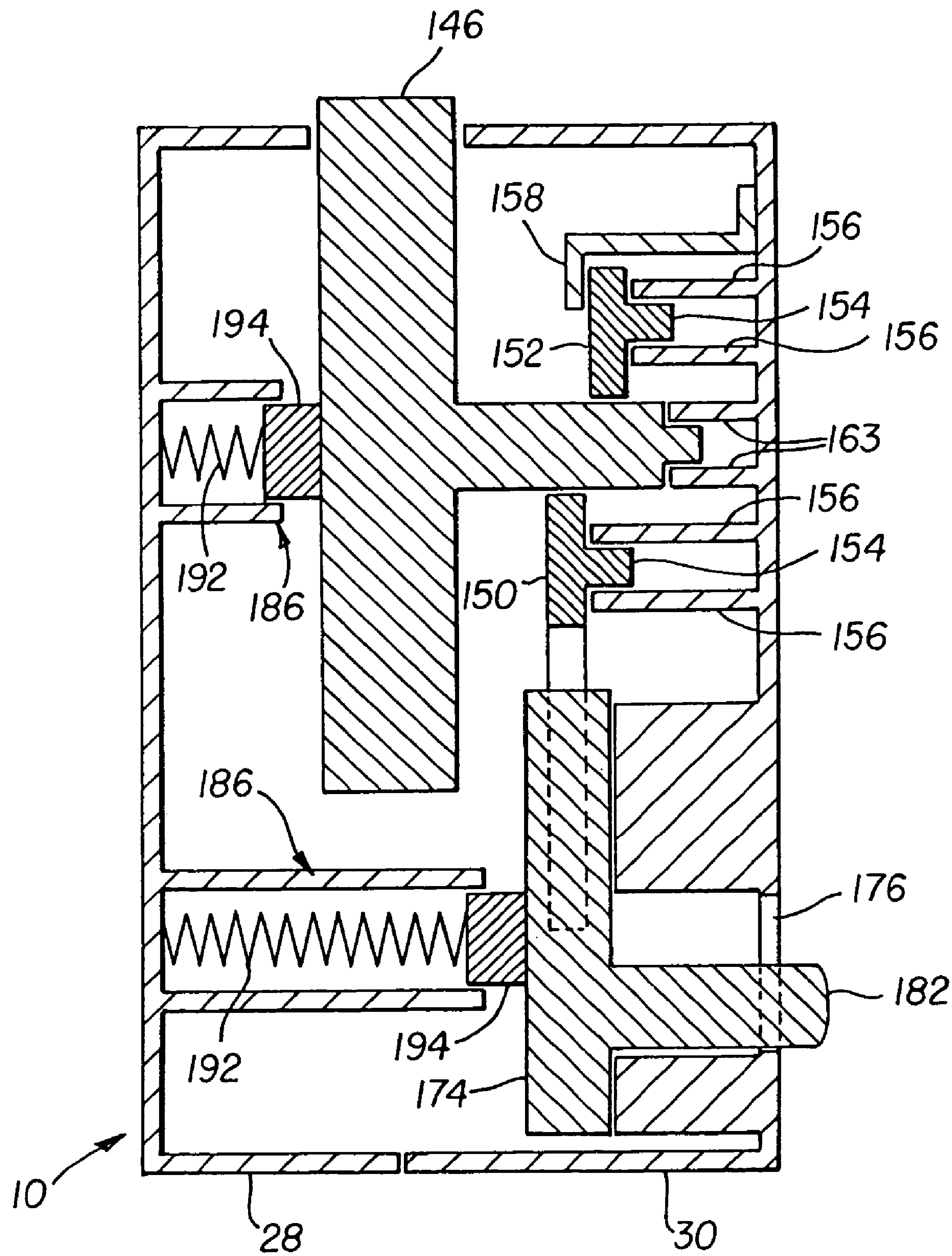
146
158
156
154
152
156
194
163
156
154
192
186
150
156
186
176
182
194
192
174
10
28
30

FIG. 34

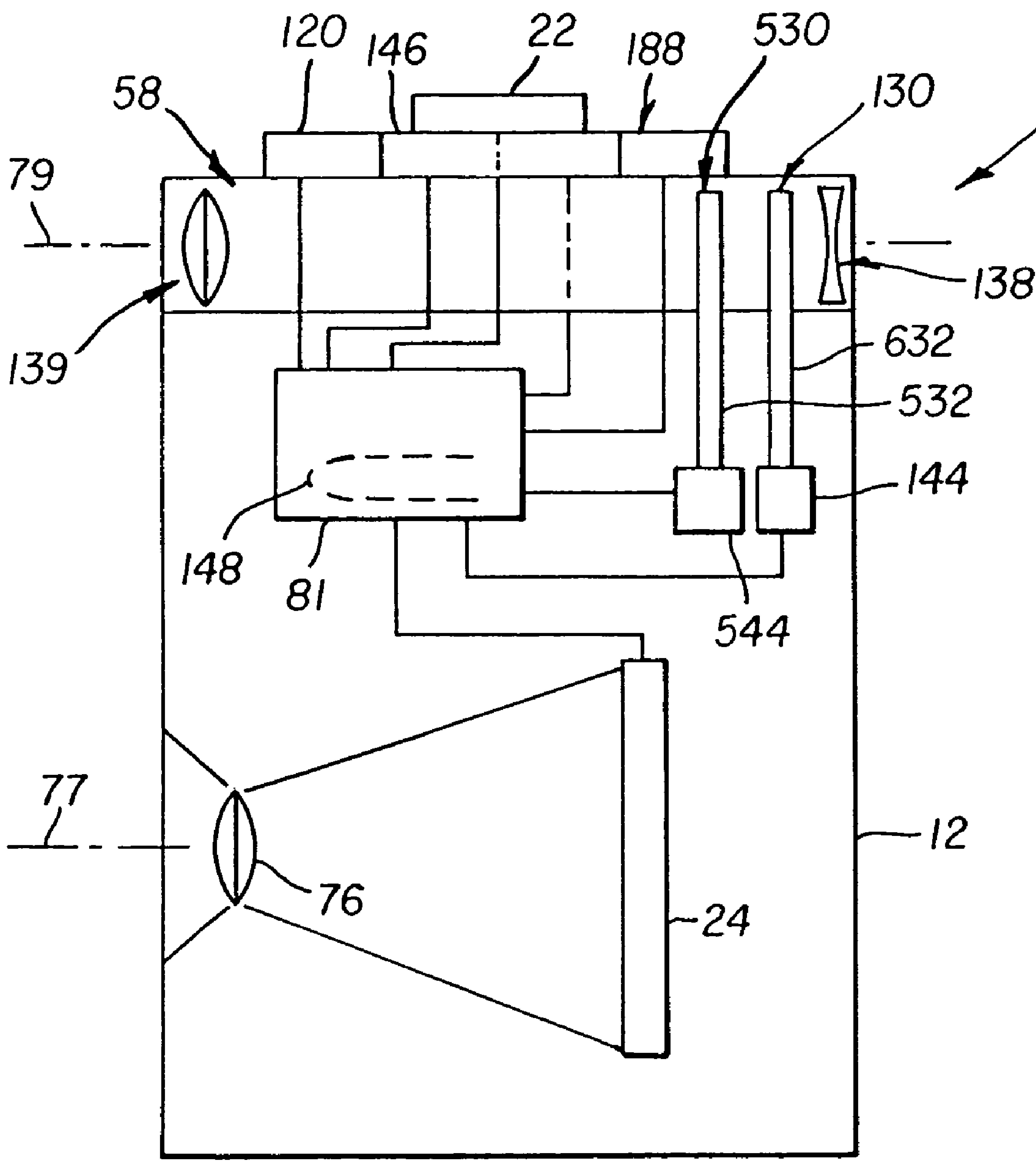
120
146
22
188
530
130
10
58
79
138
139
632
532
144
148
81
544
77
12
76
24

FIG. 35

# USER INTERFACE FOR CONTROLLING CROPPING IN ELECTRONIC CAMERA

## CROSS REFERENCE TO RELATED APPLICATIONS

This is a continuation of application Ser. No. 10/292,235, filed Nov. 12, 2002 now U.S. Pat. No. 7,006,764.

## FIELD OF THE INVENTION

The invention relates to cameras and photography and more particularly relates to a user interface for controlling cropping in an electronic camera.

## BACKGROUND OF THE INVENTION

Photographers have been zooming and cropping photographic images, after capture, since the beginnings of photography. With the availability of zoom taking lenses, viewfinder reticles and masks have been used to show the effects of zooming in the viewfinder, before capture. Zoom viewfinders and digital viewfinders are now generally used to present zoomed light images prior to capture.

Viewfinders that show possible changes in aspect ratio prior to capture have been less common. (For convenience, in the following, the term "cropping" is used to refer only to changes in an image that alter the aspect ratio and "zooming" is used to refer only to changes in an image that alter the relative size, but retain the same aspect ratio.) Some Advanced Photo System™ ("APS") cameras have had viewfinders that showed available cropping (print aspect ratios). In those cameras, the entire film frame is exposed, an encodement is recorded on the film, and the image is printed in the selected aspect ratio at photofinishing. These approaches are more convenient than cropping after printing, since the user can compose the image based upon a desired final aspect ratio seen in the viewfinder, but these approaches are limited to a few preset cropping values (aspect ratios). The user interface for controlling cropping in these cameras has been very simple, since the available cropping states are very small in number.

U.S. Pat. No. 5,619,738 discloses a hybrid camera, in which the user can edit an image on a display on the back of the camera. The user selects a print format and then moves a marker on the display to zoom, crop, and/or tilt the desired portion of the image. This approach is effective, but is again complex. The image is shown on the display along with marks that define a box showing the size of the edited image. The box is enlarged or reduced in size to indicate zooming. An input element is moved from side to side to effect zooming. The box is moved in left-right and up-down directions to crop, using input elements that move from side to side and up and down, respectively. U.S. Pat. No. 5,675,400 discloses an editor for processed film images that similarly presents a box on a displayed image. The box is zoomed, moved left-right, and moved up-down by three rotatable knobs arranged in a column. The devices disclosed in these patents provide many different cropping and zooming values. On the other hand, the input elements provided for the zooming and cropping functions, are not easily differentiated without looking at them. In U.S. Pat. No. 5,619,738, zooming and left-right movement are provided by adjoining left-right movable input elements. In U.S. Pat. No. 5,675,400, zooming and box movements are provided by rotary knobs. The user must look or remember which knob provides what function. This is not a particular



problem for editing images after capture, but would be a hindrance during composition prior to capture.

It would thus be desirable to provide an improved camera and method in which input elements are easily and conveniently used to change cropping during composition, prior to image capture.

## SUMMARY OF THE INVENTION

The invention is defined by the claims. The invention, in its broader aspects, provides a camera that adjusts the aspect ratio of a viewfinder image. The camera has a body and a capture unit mounted in the body. The capture unit has an imager and storage media operatively connected to the imager. The capture unit selectively captures an electronic image of a scene. A viewfinder of the camera displays a light image of the scene. A cropper is disposed in the body. The cropper is switchable among a plurality of settings. Each setting defines a different rectangular cross-sectioned window in the viewfinder. A cropping control is operatively connected to the capture unit and cropper. The cropping control has a cropping input element that is accessible external to the body. The cropping input element is movable between first and second opposed cropping control positions to change the settings. The cropping control positions define a cropping control axis perpendicular to an optical axis of the capture unit.

It is an advantageous effect of the invention that an improved camera and method are provided in which input elements are easily and conveniently used to change cropping during composition, prior to image capture. This allows the photographer to adjust the view position and direction in response to cropping considerations.

## BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be better understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying figures wherein:

FIG. **1** is a semi-diagrammatical view of an embodiment of the camera. For clarity, only the front cover, cropper, controller, and signal lines are shown. The cropper is shown in a center intermediate vane position. In this and other drawings, the overlap of some parts is indicated by dashed lines. For clarity, solid lines are retained for other overlaps.

FIG. **2** is a rear view of another embodiment of the camera.

FIG. **3** is a semi-diagrammatical rear perspective view of the camera of FIG. **2**. The camera is shown with the display in use as an electronic viewfinder.

FIG. **4** is a schematic diagram of the camera of FIG. **2**.

FIG. **5** is a partial schematic diagram of a modification of the camera of FIG. **2**.

FIG. **6** is a front perspective view of the camera of FIG. **5**.

FIG. **7** is a rear perspective view of a modification of the camera of FIG. **2**.

FIG. **8** is an exploded rear perspective of the camera of FIG. **7**.

FIG. **9** is a schematic diagram of another embodiment of the camera.

FIG. **10** is a semi-diagrammatical view of another embodiment of the camera. For clarity, only the front cover, cropper, and controller and signal lines are shown. The cropper is shown in a center intermediate vane position.

FIG. **11** is a semi-diagrammatical view of another embodiment of the camera. For clarity, only the front cover and cropper are shown. The cropper is shown in a fully-cropped to vertical vane position.

FIG. **12** is the same view as FIG. **11**, but the cropper is in a center intermediate vane position.

FIG. **13** is the same view as FIG. **11**, but the cropper is in a fully-cropped to horizontal vane position.

FIG. **14** is a diagram of the window defined by the cropper of the camera of FIG. **11** showing the fully-cropped vertical, fully-cropped horizontal, and five intermediate vane positions between the fully-cropped vane positions.

FIG. **15** is a semi-diagrammatical view of a modification of the camera of FIG. **11**. The cropper is shown in a fully-cropped to vertical vane position.

FIG. **16** is the same view as FIG. **15**, but the cropper is in a fully-cropped to horizontal vane position.

FIG. **17** is a semi-diagrammatical view of the front cover of a modification of the camera of FIG. **11**.

FIG. **18** is a semi-diagrammatical view of the camera of FIG. **17**. For clarity, only the front cover, cropper, and lens cover are shown. The cropper is shown in a center intermediate vane position and the lens cover in a closed position.

FIG. **19** is a semi-diagrammatical view of another embodiment of the camera. For clarity, only the front cover and cropper are shown.

FIG. **20** is a partial close-up semi-diagrammatical view of a modification of the cropper input element and front cover of the camera of FIG. **19**.

FIG. **21***a* is top view of the camera of FIG. **1**. The four way zoom-crop input element is shown in a default or normal zoom position and center intermediate cropper vane position.

FIG. **21***b* is a diagrammatical view of a viewfinder image provided by the camera of FIG. **21***a*.

FIG. **22***a* is the same view as FIG. **21***a*, but an arrow is added to indicate the effect of a user holding down the forward pad of the four way zoom-crop input element. In the camera of FIG. **21***a*, the cropping and zooming input elements continuously change respective cropper and zoom mechanism positions, as long as the respective pad is pressed and held down. Thus, in FIGS. **22***a*-**25** respective limit positions are shown.

FIG. **22***b* is a diagrammatical view of the viewfinder image provided by the camera of FIG. **22***a* following zooming of the viewfinder image responsive to the user action of FIG. **22***a*.

FIG. **23***a* is the same view as FIG. **21***a*, but an arrow is added to indicate the effect of a user holding down the leftward pad of the four way zoom-crop input element.

FIG. **23***b* is a diagrammatical view of the viewfinder image provided by the camera of FIG. **22***a* following cropping of the viewfinder image responsive to the user action of FIG. **22***a*.

FIG. **24***a* is the same view as FIG. **21***a*, but an arrow is added to indicate the effect of a user holding down the rightward pad of the four way zoo-crop input element.

FIG. **24***b* is a diagrammatical view of the viewfinder image provided by the camera of FIG. **21***a* following cropping of the viewfinder image responsive to the user action of FIG. **24***a*.

FIG. **25***a* is the same view as FIG. **21***a*, but an arrow is added to indicate the effect of a user holding down the rearward pad of the four way zoom-crop input element.

FIG. **25***b* is a diagrammatical view of the viewfinder image provided by the camera of FIG. **21***a* following zooming of the viewfinder image responsive to the user action of FIG. **25***a*.

FIG. **26** is a semi-diagrammatical view of the four-way rocker button and related circuitry of the camera of FIG. **1**. For clarity, underlying portions of the front cover of the camera are indicated by separated segments marked by cross-hatching and the shutter release is shown as a simplified switch.

FIGS. **27***a*-**27***d* are additional embodiments of the camera.

FIG. **28** is a partial semi-diagrammatical view of another embodiment of the camera. For clarity only the front cover, cropper and zoom mechanism are shown. The cropper is in a center intermediate position. The zoom mechanism is in a zoomed out position.

FIG. **29** is the same view as FIG. **28**, but the cropper is in a center intermediate position and the zoom mechanism is in a zoomed in position.

FIG. **30** is the same view as FIG. **28**, but the cropper is in a low aspect ratio position and the zoom mechanism is in a zoomed in position.

FIG. **31** is a semi-diagrammatical cross-sectional view of the camera of FIG. **12** taken substantially along line A-A of FIG. **12**.

FIG. **32** is a semi-diagrammatical cross-sectional view of the camera of FIG. **12** taken substantially along line B-B of FIG. **12**.

FIG. **33** is a semi-diagrammatical cross-sectional view of the camera of FIG. **18** taken substantially along line C-C of FIG. **18**, except that the lens cover is shown in the open position rather than in the closed position.

FIG. **34** is a semi-diagrammatical cross-sectional view of the camera of FIG. **19** taken substantially along line D-D of FIG. **19**.

FIG. **35** is a diagrammatical cross-section of another embodiment of the camera.

## DETAILED DESCRIPTION OF THE INVENTION

The camera provides the photographer with a single input element that provides for continuous adjustment of image aspect ratio, while providing an immediate view of the resulting selected image boundaries during composition. In particular embodiments, zoom control is provided by the same, or an adjoining input element. In particular embodiments disclosed herein, the aspect ratio of the image in an optical viewfinder is altered by mechanical vanes. An archival image captured at picture taking, is subject to cropping or cropping information is provided, based on the position of the vanes. This approach is especially well-suited to a digital camera or hybrid film-digital camera, but is also applicable to film cameras as well.

In the following, feature sets of the several different cameras and methods are discussed in terms of particular embodiments combining all or many of those features. Alternative embodiments combining fewer features and alternative features are also discussed herein. Other alternatives will be apparent to those of skill in the art. Viewfinder location in the cameras shown is selected for clarity of the drawings. In an actual camera, viewfinder location may differ. The camera is discussed below, generally in terms of a hybrid film-digital camera or a digital still camera. Like considerations apply to digital video cameras and film only cameras.

Referring now particularly to FIGS. **1**-**9** and **35**, in particular embodiments, the camera **10** has a body **12** that holds a capture system having an archival image capture unit **16** and a evaluation capture unit **18**. The two different capture units **16**,**18** can take a variety of forms and can be completely separate from each other or can share some or most components. The evaluation capture unit **18** captures a scene image electronically and can also be referred to as an electronic image capture unit **18**. The archival image capture unit **16** can capture images electronically or on film. If the archival image capture unit **16** captures latent images using photographic film as the archival media, it is referred to herein as a "film image capture unit **20**".

In an embodiment of the camera **10** having a film image capture unit **20**, when the photographer trips a shutter release **22**, a subject image **23** (a light image of a scene) is captured as a latent image on a frame of the film **41** and at least one electronic image is captured on an electronic array imager **24** of the evaluation capture unit **18**. The electronic image or images are digitally processed and used to provide one or more derived images that can be shown on an image display **26** mounted to the body **12**. The electronic images, as captured in analog form and after digitization, but not other modification, are referred to generically herein as "original electronic images". After further modification, inclusive of any zooming and cropping, the electronic images are referred to generically herein by the term "derived images". Derived images are also modified relative to the original images for calibration to the display or a particular file structure, or matching to particular presets, such as output media to be used for a final image. These modifications may or may not also include the addition of metadata. With a hybrid camera, a derived image that is matched to the expected product of photofinishing a film archival image is also referred to herein as a "verification image". More than one derived image can be made from a single original electronic image. A derived image that is used for a digital viewfinder, rather than as a digital archival image, is referred to herein as an "evaluation image".

The camera body **12** provides structural support and protection for the capture units **16**,**18** and other components. The body **12** of the camera **10** can be varied to meet requirements of a particular use and style considerations. It is convenient, if the body **12** has front and rear covers **28**,**30** joined together over a chassis **32**. Many of the components of the camera **10** can be mounted to the chassis **32**. A film door **34** and a flip-up flash unit **36** are pivotably joined to the covers **28**,**30** and chassis **32**.

The film image capture unit **20** has a film holder **38** that holds a film unit **40** during use. In the camera **10** of FIGS. **7**-**8**, the film holder **38** is part of the chassis **32**. (The term "film unit" is used to refer to photographic film and any accompanying canister or other support structure or light block, or the like.)

The configuration of the film holder **38** is a function of the type of film unit **40** used. The type of film unit **40** used is not critical. The camera **10** shown in the figures is film reloadable and uses an Advanced Photo System ("APS") film cartridge. Other types of one or two chamber film cartridge could also be used and roll film can also be used. It is currently preferred that the camera **10** is reloadable. The camera **10** can have a IX-DX code reader (not shown) to determine the film type and a data recorder **39** to write data on the film indicating how many prints of each film frame to produce, print format, and the like. This is not limiting. Information including metadata can be read and written by any means well known to those of skill in the art.

The film holder **38** includes a pair of film chambers **42**,**44** and an exposure frame **45** between the film chambers **42**,**44**. The film unit **40** has a canister **46** disposed in one of the chambers. A filmstrip **41** is wound around a spool **48** held by the canister **46**. During use, the filmstrip **41** extends across the exposure frame **45** and is wound into a film roll in the other chamber. The exposure frame **45** has an opening **50** through which a light image exposes a frame of the film **41** at each picture-taking event.

During use, the filmstrip **41** is moved by a film transport **52** out of the canister **46** of the film cartridge **40**, is wound into a film roll in the supply chamber **42**, and is then returned to the canister **46**. The film transport **52**, as illustrated, includes an electric motor located within a supply spool **49**, but other types of motorized transport mechanisms and manual transports can also be used. Filmstrip exposure can be on film advance or on rewind.

The electronic image capture unit **18** has an electronic array imager **24**. The electronic array imager **24** is configured so as to capture, for each picture-taking event, one or more electronic images that correspond to a latent image concurrently captured on the filmstrip **41**. The type of imager **24** used may vary, but it is highly preferred that the imager **24** be one of the several solid-state imagers available. One highly popular type of solid-state imager commonly used is the charge-coupled device ("CCD"). Of the several CCD types available, two allow easy electronic shuttering and thereby are preferable in this use. The first of these, the frame transfer CCD, allows charge generation due to photoactivity, and then shifts all of the image charge into a light shielded, non-photosensitive area. This area is then clocked out to provide a sampled electronic image. The second type, the interline transfer CCD, also performs shuttering by shifting the charge, but shifts charge to an area above or below each image line so that there are as many storage areas as there are imaging lines. The storage lines are then shifted out in an appropriate manner. Each of these CCD imagers has both advantages and disadvantages, but all will work in this application. A typical CCD has separate components that act as clock drivers, analog signal processor-analog/digital converter **104** (also referred to as "A/D converter **104**"). It is also possible to use an electronic image sensor manufactured with CMOS technology. This type of imager is attractive for use, since it is manufactured easily in a readily available solid-state process and lends itself to use with a single power supply. In addition, the process allows peripheral circuitry to be integrated onto the same semiconductor die. For example, a CMOS sensor can include clock drivers, the A/D converter, and other components integrated on a single IC. A third type of sensor, which can be used, is a charge injection device (CID). This sensor differs from the others mentioned in that the charge is not shifted out of the device to be read. Reading is accomplished by shifting charge within the pixel. This allows a nondestructive read of any pixel in the array. If the device is externally shuttered, the array can be read repeatedly without destroying the image. Shuttering can be accomplished by external shutter or, without an external shutter, by injecting the charge into the substrate for recombination.

The electronic image capture unit **18** captures a three-color image. It is highly preferred that a single imager be used along with a three-color or four color filter, however, multiple monochromatic imagers and filters can be used. Suitable three-color filters are well known to those of skill in the art, and are normally incorporated with the imager to provide an integral component. For convenience, the camera is generally discussed herein in relation to embodiments having a single imager with a three color filter (not separately illustrated). It will be understood that like considerations apply to cameras using more than three colors as well as cameras using multiple monochromatic imagers.

Referring to FIG. **9**, in some embodiments the archival image capture unit is an electronic image capture unit **18** that captures the archival image electronically and stores the archival image in digital form. In this latter case, the "capture media" is digital storage media, such as electronic or magnetic memory and the archival images are transferred in digital form for photofinishing. The memory **54** may be fixed in the camera **10** or removable. The type of memory used and the manner of information storage, such as optical or magnetic or electronic, is not critical. For example, removable memory can be a floppy disc, a CD, a DVD, a tape cassette, or flash memory card or stick. The transfer of images in digital form can be on physical media or as a transmitted electronic signal.

Two electronic capture units **16**,**18** can be present in the camera **10**, with one used as the evaluation capture unit **18** and the other used as the archival capture unit. An example of a suitable digital camera having two such electronic capture units is described in U.S. Pat. No. 5,926,218, entitled "ELECTRONIC CAMERA WITH DUAL RESOLUTION SENSORS", to Smith. Alternatively, a single electronic capture unit can be used as both the evaluation capture unit and the archival image capture unit. In this case, the archival image is derived from the original electronic image by an archival image definition unit and the scene is defined by the effective field of view resulting from this operation. With a fully electronic camera **10**, the derived images can be subsampled from the original electronic image so as to provide lower resolution derived images. The lower resolution derived images can be provided using the method described in commonly-assigned U.S. Pat. No. 5,164,831, entitled "ELECTRONIC STILL CAMERA PROVIDING MULTI-FORMAT STORAGE OF FULL AND REDUCED RESOLUTION IMAGES", to Kuchta, et al.

The camera **10** can alternatively allow use of either a film image capture unit **20** or an electronic capture unit as the archival image capture unit **16**, at the selection of the photographer or on the basis of available storage space in one or another capture media or on some other basis. For example, a switch (not separately illustrated) can provide alternative film capture and electronic capture modes. The camera **10** otherwise operates in the same manner as the other described embodiments.

Referring now primarily to FIGS. **4**-**5**, **9**, and **35** the camera **10** has an optical system **56** of one or more lenses mounted in the body **12**. The optical system **56** is illustrated in FIGS. **4**-**5** and **9** by a dashed line and several groups of lens elements. It will be understood that this is illustrative, not limiting. The optical system **56** directs light to the exposure frame **45** (if present) and to the electronic array imager **24**. The optical system **56** also preferably directs light through an optical viewfinder **58** to the user. Referring to FIG. **35**, the taking lens unit **76** defines an optical axis **77**. The viewfinder lens unit **68** defines a viewfinder axis **79**. The taking lens **76** and viewfinder lens **68** define a capture light path and a viewfinder light path, respectively.

Referring to FIGS. **4**-**5**, in hybrid embodiments, the imager **24** is spaced from the exposure frame **45**; thus, the optical system **56** directs light along a first path (indicated by a dotted line **60**) to the exposure frame **45** and along a second path (indicated by a dotted line **62**) to the electronic array imager **24**. Both paths **60**,**62** converge at a position in front of the camera **10**, at the plane of the subject image **23**. In FIG. **4**, the optical system **56** has a combined lens unit **64** that includes both an imager lens unit **66** and a viewfinder lens unit **68**. The combined lens unit **64** has a partially transmissive mirror **70** that subdivides the second light path **62** between an imager **24** subpath **62***a* to the imager **24** and a viewfinder subpath **62***b* that is redirected by a fully reflective mirror **72** and transmitted through an eyepiece **74** to the photographer.

The optical system **56** can be varied. For example, the viewfinder lens unit **68**, imager lens unit **66**, and a taking lens unit **76** can be fully separate, as shown in FIG. **5**, or a combined lens unit can include both a taking lens unit and an imager **24** lens unit (not shown). Other alternative optical systems can also be provided.

In most cameras **10**, there is a variation between the field of view of the viewfinder **58** and the field of view of the archival image capture unit **16**. The scene delineated by the viewfinder **58** is typically 80 to 95 percent of the field of view of the archival image capture unit **16**. The difference ensures that everything the photographer sees will be captured in the archival image, albeit with some additional image content at the edges. Cameras **10** are generally described and illustrated herein in terms of viewfinders **58** that have a 100 percent match to the field of view of the archival image capture unit **16**. This is a matter of convenience in describing the invention. The viewfinders **58** of the cameras **10** can be limited to 80 to 95 percent of the field of view of the archival image capture unit **16** without changing the other features described.

Referring again to the embodiment shown in FIG. **4**, the taking lens unit **76** is a motorized zoom lens in which a mobile element or elements are driven, relative to a stationary element or elements, by a zoom driver **78**. The combined lens unit **64** also has a mobile element or elements, driven, relative to a stationary element or elements, by a zoom driver **78**. The different zoom drivers **78** are coupled so as to zoom together, either mechanically (not shown) or by a control system **80** signaling the zoom drivers **78** to move the zoom elements of the units over the same or comparable ranges of focal lengths at the same time. The control system **80**, which includes a controller **81**, can take the form of an appropriately configured microcomputer, such as an embedded microprocessor having RAM or other memory **54** for data manipulation and general program execution.

The taking lens unit **76** of the embodiment of FIG. **4** is also autofocusing. An autofocusing system **82** has a rangefinder **86** that includes a sensor **84**. The rangefinder operates a focus driver **88**, directly or through the control system **80**, to move one or more focusable elements (not separately illustrated) of the taking lens unit **76**. The rangefinder **86** can be passive or active or a combination of the two. The taking lens unit **76** can be simple, such as having a single focal length and manual focusing or a fixed focus, but this is not preferred. One or both of the viewfinder lens unit **68** and imager lens unit **66** can have a fixed focal length or one or both can zoom between different focal lengths. Digital zooming (enlargement of a digital image equivalent to optical zooming) can also be used instead of or in combination with optical zooming.

The imager **24** and image display **26** can be used as a viewfinder **58** prior to image capture in place of or in combination with the optical viewfinder **58**, as is commonly done with digital still cameras **10**. This approach is not currently preferred, since battery usage is greatly increased.

A film shutter **92** shutters the light path to the exposure frame **45**. An imager shutter **94** shutters the light path to the imager **24**. Diaphragms/aperture plates **96** can also be provided in both of the paths. Each of the shutters **92**,**94** is switchable between an open state and a closed state. The term "shutter" is used in a broad sense to refer to physical and/or logical elements that provide the function of allowing the passage of light along a light path to a filmstrip or imager **24** for image capture and disallowing that passage at other times. "Shutter" is thus inclusive of, but not limited to, mechanical and electromechanical shutters of all types. "Shutter" is not inclusive of film transports and like mechanisms that simply move film or an imager **24** in and out of the light path. "Shutter" is inclusive of computer software and hardware features of electronic array imagers **24** that allow an imaging operation to be started and stopped under control of the camera controller.

In currently preferred embodiments, the film shutter **92** is mechanical or electromechanical and the imager shutter **94** is mechanical or electronic. The imager shutter **94** is illustrated by dashed lines to indicate both the position of a mechanical imager shutter and the function of an electronic shutter. When using a CCD, electronic shuttering of the imager **24** can be provided by shifting the accumulated charge under a light shielded register provided at a non-photosensitive region. This may be a full frame as in a frame transfer device CCD or a horizontal line in an interline transfer device CCD. Suitable devices and procedures are well known to those of skill in the art. When using a CID, the charge on each pixel is injected into a substrate at the beginning of the exposure. At the end of the exposure, the charge in each pixel is read. The difficulty encountered here is that the first pixel read has less exposure time than the last pixel read. The amount of difference is the time required to read the entire array. This may or may not be significant depending upon the total exposure time and the maximum time needed to read the entire array.

Signal lines **98** electronically connect the various components, for example, connecting the imager **24** through the control system **80** to the image display **26**. The imager **24** receives a light image and converts the light image to an analog electrical signal, that is, an analog electronic image. (For convenience, electronic images are generally discussed herein in the singular. Like considerations apply to each image of a plurality captured for a particular picture-taking event.)

The electronic imager **24** is driven by the imager driver **100**. The image display **26** mounted on the outside of the camera body **12** is driven by an image display driver **102** and produces a light image (also referred to here as a "display image") that is viewed by the user.

The control system **80** controls other components of the camera **10** and performs processing related to the derived image. The control system **80**, as earlier discussed, includes the controller **81** and memory **54** and also includes an A/D converter **104** and an image processor **106**. Other components can also be provided, as discussed below, in detail. Suitable components for the control system **80** are known to those of skill in the art. Modifications of the control system **80** are practical, such as those described elsewhere herein. The controller **81** can be provided as a single component, such as a microprocessor, or as multiple components of equivalent function in distributed locations. The same considerations apply to the processor **106** and other components. Likewise, components illustrated as separate units herein may be conveniently combined or shared in some embodiments.

"Memory **54**" refers to one or more suitably sized logical units of physical memory provided in semiconductor memory or magnetic memory, or the like. For example, the memory **54** can be an internal memory, such as a Flash EPROM memory, or alternately a removable memory, such as a CompactFlash card, or a combination of both. The controller **81** and image processor **106** can be controlled by software stored in the same physical memory **54** that is used for image storage, but it is preferred that the processor **106** and controller **81** are controlled by firmware stored in dedicated memory **54**, for example, in a ROM or EPROM firmware memory. Separate dedicated units of memory **54** can also be provided to support other functions.

The captured analog electronic image is amplified and converted by the analog to digital (A/D) converter-amplifier **104** to a digital electronic image, which is then processed in the image processor **106** and stored in the memory **54**. It is currently preferred that the signal lines **98** act as a data bus connecting the imager **24**, controller **81**, processor **106**, the image display **26**, and other electronic components.

The controller **81** includes a timing generator (not separately illustrated) that supplies control signals for all electronic components in timing relationship. Calibration values for the individual camera **10** are stored in a calibration memory **54** (not separately illustrated), such as an EEPROM, and supplied to the controller **81**. The controller **81** operates the memory or memories **54** and the drivers including the zoom drivers **78**, focus driver **88**, imager driver **100**, image display driver **102**, aperture drivers **108**, and film and imager shutter drivers **110**,**112**. The controller **81** connects to a flash circuit **115** that mediates flash functions.

It will be understood that the circuits shown and described can be modified in a variety of ways well known to those of skill in the art. It will also be understood that the various features described here in terms of physical circuits can be alternatively provided as firmware or software functions or a combination of the two. Likewise, components illustrated as separate units herein may be conveniently combined or shared in some embodiments.

The digital electronic image stored in memory **54**, is accessed by the processor **106**, and is modified so as to provide a required derived image. As a part of showing a derived image on the image display **26**, the camera **10** may modify the derived image for calibration to the particular display **26**. For example, a transform can be provided that modifies each image to accommodate the different capabilities in terms of gray scale, color gamut, and white point of the display **26** and the imager **24** and other components of the electronic capture unit. It is preferred that the display **26** is selected so as to permit all of the derived image to be shown, at an acceptable size and resolution, without requiring panning by the user or other user action; however, more limited displays **26** can be used.

The derived images can also be modified in the same manner that images are commonly enhanced in digital cameras. For example, processing can provide interpolation and edge enhancement. With a verification image in a hybrid digital-film embodiment, enhancements should be limited so as to not render the derived image dissimilar to the corresponding photofinished archival image. If the archival image is an electronic image, then comparable enhancements can be provided for both verification and archival images. Digital processing of an electronic archival image can also include modifications related to file transfer, such as, JPEG compression, and file formatting.

Enhancements can be provided to match the calibrated derived image to output characteristics of a selected photofinishing channel. Photofinishing related adjustments assume foreknowledge of the photofinishing procedures that will be followed for a particular unit of capture media. This foreknowledge can be made available by limiting photofinishing options for a particular capture media unit or by standardizing all available photofinishing or by requiring the user to select a photofinishing choice, for example by entering a character on a control pad or setting a switch. This designation can then direct the usage of particular photofinishing options and can provide for a direct or indirect indication of the effect in a derived image. The application of a designation on a capture media unit could be provided by a number of means known to those in the art, such as application of a magnetic or optical code.

Derived images can be prepared from the electronic image before being needed or as needed, as desired, subject to the limitations of processing speed and available memory. To minimize the size of the memory **54**, an electronic image can be processed and stored as a lower resolution image, before a succeeding image is read out from the imager **24**.

The controller **81** facilitates the transfers of the image, along the signal lines, between the electronic components and provides other control functions, as necessary. The controller **81** includes a timing generation circuit (not separately illustrated) that produces control signals for all electronic components in timing relationship. The controller **81** is illustrated as a single component, but it will be understood that this is a matter of convenience in illustration. The controller **81** can be provided as multiple components of equivalent function in distributed locations. The same considerations apply to the processor **106** and other components. Likewise, components illustrated as separate units herein may be conveniently combined or shared in some embodiments.

Different types of image display **26** can be used. For example, the image display **26** can be a liquid crystal display ("LCD"), a cathode ray tube display, or an organic electroluminescent display ("OELD"; also referred to as an organic light emitting display, "OLED").

The image display **26** is preferably mounted on the back or top of the body **12**, so as to be readily viewable by the photographer. One or more information displays **114** can be provided on the body **12**, to present camera information to the photographer, such as exposures remaining, battery state, flash state, number of prints ordered, and the like. For convenience, the information display **114** is generally discussed here in the singular. The information display **114** provides a variety of camera related information and can include a warning message if an archival image will provide an unsuitable quality print or other final image after photofinishing, as discussed below, in detail. The information display **114** and image display **26** can be provided by separate display devices or both can be provided by contiguous parts of a common display device. The information display **114** can be deleted if information is instead provided on the image display **26** as a superimposition on the image or alternately instead of the image (not illustrated). If separate, the information display **114** is operated by an information display driver **116**. The image display **26**, and an information display **114**, can be mounted instead or additionally so as to be viewable through the viewfinder as a virtual display (not shown).

It is preferred that the image display **26** is operated on demand by actuation of a switch (not separately illustrated) and that the image display **26** is turned off by a timer or by initial depression of the shutter release **22**. The timer can be provided as a function of the controller **81**.

Referring now particularly to FIGS. **4-5**, **9**, and **35** the camera **10** has user input elements including the shutter release **22**, a cropper input element **146**, a zooming input element **120**, and other user control features **122**. (The latter two are discussed in detail below.) The shutter release **22** operates both shutters **92**,**94**. To take a picture, the shutter release **22** is actuated by the user and trips from a set state to an intermediate state, and then to a released state. The shutter release **22** is typically actuated by pushing, and, for convenience the shutter release **22** is generally described herein in relation to a shutter button that is initially depressed through a "first stroke", to actuate a first switch S**1** and alter the shutter release **22** from the set state to the intermediate state and is further depressed through a "second stroke", to actuate a second switch S**2** and alter the shutter release **22** from the intermediate state to the released state. Like other two stroke shutter releases **22** well known in the art, the first stroke actuates exposure-delimiting camera components, such as autofocus, autoexposure, and flash unit readying; and the second stroke actuates capture of the archival image.

Referring now to FIG. **4**, when the shutter release **22** is pressed to the first stroke, the taking lens unit **76** and combined lens unit **64** are each autofocused to a detected subject distance based on subject distance data sent by the rangefinder **86** to the controller **81**. The controller **81** also receives data indicating what focal length the lens units **76**,**64** are set at from one or both of the zoom drivers **78** or a zoom sensor (not shown). The camera **10** also detects the film speed of the film cartridge **40** loaded into the camera **10** using a film unit detector **124** and relays this information to the controller **81**. The camera **10** obtains scene brightness (By) from components, discussed below, that function as a light meter. The scene brightness and other exposure parameters are provided to an algorithm in the controller **81**, which determines a focused distance, shutter speeds, apertures, and optionally a gain setting for amplification of the analog signal provided by the imager **24**. Appropriate signals for these values are sent to the drivers **88**,**100**,**108**,**110**,**112** via a motor driver interface (not shown) of the controller **81**. The gain setting is sent to the ASP-A/D converter **104**.

The camera **10** assesses ambient lighting using the imager **24** or a separate detector **126** (indicated by dashed lines in the figures) or both. The detector has an ambient detector driver **128** that operates a single sensor **129** or multiple sensors (not shown). The ambient light detector or sensors can receive light from the optical system **56** or can be illuminated external to the optical system **56**.

In some embodiments, the evaluation capture unit **18** is used to assess ambient lighting. In those embodiments, one or more electronic images are captured prior to capture of the archival image. The captured electronic image data from one or more of these preliminary images is sampled and scene parameters, such as automatic setting of shutter speeds and diaphragm settings, are determined from that data. These preliminary electronic images can be captured in a continuing sequence as long as the capture system **14** is in a preliminary mode. For example, preliminary images can be captured, seriatim, as long as the shutter release **22** is actuated through the first stroke and is maintained in that position. This capture of preliminary images ends when the shutter release **22** is returned to a stand-by position or is actuated through the second stroke for archival image capture. The preliminary electronic images could be saved to memory **54**; but, except as otherwise described here, are ordinarily discarded, one after another, when the replacement electronic image is captured to reduce memory **54** usage. The preliminary images can also be provided to the image display **26** for use by the photographer, prior to picture taking, in composing the picture. This use of the image display **26** as an electronic viewfinder greatly increases energy usage and is not preferred for that reason.

The electronic capture unit is calibrated during assembly, to provide measures of illumination, using known values. For example, the controller **81** can process the data presented in a preliminary image using the same kinds of light metering algorithms as are used for multiple spot light meters. The procedure is repeated for each succeeding preliminary image. Individual pixels or groups of pixels take the place of the individual sensors used in the multiple spot light meters. For example, the controller **81** can determine a peak illumination intensity for the image by comparing pixel to pixel until a maximum is found. Similarly, the controller **81** can determine an overall intensity that is an arithmetic average of all of the pixels of the image. Many of the metering algorithms provide an average or integrated value over only a selected area of the imager array **24**, such as an upper middle region. Another approach is to evaluate multiple areas and weigh the areas differently to provide an overall value. For example, in a center weighted system, center pixels are weighted more than peripheral pixels. The camera **10** can provide manual switching between different approaches, such as center weighted and spot metering. The camera **10** can alternatively, automatically choose a metering approach based on an evaluation of scene content. For example, an image having a broad horizontal bright area at the top can be interpreted as sky and given a particular weight relative to the remainder of the image.

Under moderate lighting conditions, the imager **24** can provide light metering and color balance determination from a single preliminary image. More extreme lighting conditions can be accommodated by use of more than one member of the series of preliminary electronic images while varying exposure parameters until an acceptable electronic image has been captured. The manner in which the parameters are varied is not critical.

After the controller **81** receives the scene brightness value, the controller **81** compares scene brightness to a flash trip point. If the light level is lower than the flash trip point, then the controller **81** enables full illumination by the flash unit **36**, unless the user manually turned the flash off. Appropriate algorithms and features for these approaches are well known to those of skill in the art.

A second switch S2 actuates when the shutter release **22** is further pushed to a second stroke. When the second switch S2 actuates, the film shutter **92** is tripped and the capture of the latent image exposure on the film frame begins. The film shutter **92** momentarily opens for a duration referred to herein as an "archival image exposure time interval". The imager shutter **94** is also actuated and momentarily opens one or more times during the archival image exposure time interval.

Referring now to FIGS. **1**, **9-20**, **28**, and **35** in particular embodiments, a mechanical cropper **130** is mounted in the body **12** of the camera **10**. The cropper **130** has pair of vanes **132**,**134**. The vanes **132**,**134** together define a window **136** in the viewfinder light path. The position of the vanes **132**,**134** is controlled by a vane driver **142**. The vanes **132**,**134** can be located anywhere along the viewfinder **58**, but it is preferred that the vanes **132**,**134** are located against either the front cover **28** or the rear cover **30**. In the following discussion of various embodiments, the vanes **132**,**134** are located against the inside of the front cover, unless specifically indicated otherwise.

The cropper input element **146** is part of the cropper **130** and is operatively connected to the rest of the vane driver **142** directly or through the controller **81**. The cropper input element **146** allows the user to move the vanes **132**,**134** from any one of the positions to any other. In the embodiments of FIGS. **1** and **10**, the cropper input element **146** is a user manipulated electrical switch that extends through the shell of the body **12** to the outside. Manual input elements and other kinds of electrical switches and controls can also be used. For example, a voice operated control circuit (not shown) can be used.

Each vane **132**,**134** is movable toward and away from the viewfinder axis **79**, so as to differently intercept the viewfinder light path. The two vanes **132**,**134** move in parallel and in opposite directions (indicated by arrow **137**), along respective members of a pair of movement axes **31**,**33** (shown in FIG. **10**). Each vane **132**,**134** moves back and forth oblique to the legs **133**,**135** and to the height and width dimensions of the window **136**.

In the embodiments disclosed herein, the vanes move along movement axes **31**,**33** that are at an oblique angle to the legs **133**,**135** and to the height and width dimensions of the window **136**. The vanes **132**,**134**, are flattened and perpendicular to the viewfinder axis **79**, and closely adjoin each other in an axial direction. The vanes **132**,**134** are L-shaped. The two legs **133**,**135** of each L are orthogonal. In each position of the vanes **132**,**134**, the window **136** is rectangular in a cross-section aligned with the viewfinder entrance **139** and viewfinder exit **138**. This is in accord with conventional photofinishing systems, in which hard copy output is rectangular. Vane shape could be varied to show other shapes of final images.

The vanes **132**,**134** are movable, as selected by the user and relative to each other and the viewfinder axis **79**, between first and second positions. In the embodiments discussed herein, except as otherwise indicated, the first and second positions are end positions, beyond which further vane movement is not possible or beyond which further vane movement does not change the window in the viewfinder **58**. The vanes **132**,**134** can be paused in the first and second positions and in any intermediate position between the first and second positions. (As an option, the vanes **132**,**134** can be movable toward each other until the entire viewfinder light path is occluded and all light is blocked or filtered. This inactive mode is not referred to herein as a "position" of the vanes **132**,**134**.)

The edges **140** of the vanes **132**,**134** that form the window **136** surround an unblocked and unfiltered portion of the viewfinder light path. The remainder of the viewfinder light path is blocked or filtered. In the former case, the vanes **132**,**134** are made of opaque material. In the latter case, the vanes **132**,**134** are filter stock.

In the embodiment shown in FIG. **10**, the vane driver **142** includes a motor **144** connected to the vanes **132**,**134** and a cropper input element **146** that is actuated by the user to change the position of the vanes. The motor **144** is connected to the controller **81** by a signal line. Electrical power can be supplied to the motor by a battery or other power source (not shown) through the control system or directly.

The vane driver **142** preferably moves the vanes **132**,**134** reciprocally in tandem and symmetrically about the viewfinder axis **79**. The movement of the vanes **132**,**134** changes the size, and preferably, the shape of the window **136**. (Window shape is generally described herein in terms of the aspect ratio of the height dimension to the width dimension.)

The vane driver **142** can be mechanical or electrical or can combine the two. In a simple case, the two vanes **132**,**134** can each be operated by a motor **144** actuated as required, by the controller **81**. For example, the motor **144** can be a stepper motor or servomotor with an appropriate circuit. Alternatively, separate motors for each vane can be operated in tandem by the controller **81**. The motor or motors can operate the vanes **132**,**134** indirectly through a gear train or other mechanism. Manual operation can also be provided. With a manually driven cropper **130**, the cropping input element **146** is mechanically coupled to the vanes **132**,**134**. In the embodiments of FIGS. **11-18**, the cropper input element **146** extends through the body **12** to the outside. The mechanical coupling is direct between the cropping input element **146** and the vanes **132**,**134**; that is there is no intermediate part that moves separately from the cropping input element **146** between the cropping input element **146** and the vanes **132**,**134**. This approach has the advantage of simplicity.

The intermediate positions of the vanes extend continuously between the first and second positions. In other words, the intermediate positions are large in number and are evenly spaced between the first and second positions. The limit on the number and spacing of intermediate positions is a function of the vane driver **142**. Inherent limitations on the positioning of such drive components as stepper motors and gear trains are well known to those of skill in the art and can be varied as desired, within practical and economic limitations.

Referring now to FIGS. **10-13**, in particular embodiments, the window **136** is square when the vanes **132**,**134** are in a center intermediate position midway between the first and second positions. In this case, when the vanes **132**,**134** are moved, the aspect ratio (width to height) of the window **136** varies continuously and is different in every position of the vanes **132**,**134**. Some of the aspect ratios available in the embodiment of FIGS. **11-13** are shown in FIG. **14**. The aspect ratio in the first position (indicated by reference numeral **401**) is a narrow vertical aspect ratio. In the second position **402**, the aspect ratio is narrow and horizontal. The aspect ratio of one is the inverse of the aspect ratio of the other. (The terms first and second positions are arbitrary.) In the embodiment shown in FIGS. **11-13**, the aspect ratios in the first and second positions are 1 to 5 and 5 to 1, respectively. In intermediate positions **403**,**404**,**405**,**406**,**407** the aspect ratio varies, with a square aspect ratio **405** in the center intermediate position. The embodiment shown in FIGS. **15-16** is similar, but the aspect ratios are less extreme in the first and second positions.

The vane driver **142** can have a repositioner **148** (illustrated in FIG. **35**, as a dashed line box) that moves the vanes **132**,**134** to one or more predetermined positions under certain preassigned conditions. A simple repositioner **148** can be in the form of appropriate programming in the controller **81** that returns the vanes **132**,**134** to the default position whenever a predetermined condition is encountered; for example, when the camera **10** is turned off or turned on. This allows the camera **10** to start in a consistent initial state. A mechanical equivalent of this default repositioner **148** is a centering spring (not shown) that returns the cropper input element **146** to a centered position when released by the user.

The vane position or positions provided by the repositioner **148** can be any of the available positions. For example, a convenient default aspect ratio is a square in the middle between vertical and horizontal non-square aspect ratios. Another convenient default state is an aspect ratio that matches the aspect ratio of the imager **24**. This aspect ratio provides the greatest number of pixels. With a hybrid film-digital camera **10**, a convenient aspect ratio for dual mode image capture (digital and film) is either the native (uncropped) aspect ratio of a film frame or the aspect ratio of the imager **24**.

The controller **81** is provided with inputs defining the position of the vanes **132**,**134**. Those inputs are used to either crop the electronic image at or immediately after capture or to record metadata with the digital image, defining cropping information or, with a hybrid camera, to record similar metadata (optical, magnetic or in some other form) in association with the respective film image. An electrical input element can supply the necessary inputs directly to the controller.

A mechanical input element can supply the inputs by use of a sensor. An infrared emitter-detector pair **147** is shown in FIG. **31** positioned on either side of an extension **150** bearing optical synchronizer markings (not illustrated). Movement of the markings is detected and the digital image is cropped accordingly. Sensors used to detect movement of zoom lenses are well known to those of skill in the art and can be used here to detect movement of an extension or vane (or zoom arm discussed below) in the same manner as detecting movement of a zoom lens component.

A mechanical input element can supply the inputs directly to an electrical input element within the camera body; for example, the shaft of the pinion can be coupled directly or indirectly to a variable resistor.

The controller **81** can be programmed to retain the vanes **132**,**134** in a current position until an action is taken or a predetermined amount of time has elapsed or the camera state has changed due to a timed power down, or the like. This exploits a principle of "locality of aspect ratio" that assumes that the photographer's currently selected aspect ratio is likely to either match or be close to the aspect ratio that will be desired for the next photograph. The opposite approach can also be provided. In that case, the camera **10** resets to the default vane position after every exposure.

FIG. **20** illustrates a repositioner **148** having three preset positions. The cropper input element **146** is a slider that protrudes through a slot in a cover **28** of the camera **10**. The cover **28** of the camera **10** has three spaced spring-loaded detents **149** and an adjoining surface of the cropper input element **146** has a cup-shaped cut-out **151** that can receive the detents **149**. In this case, the vanes **132**,**134** can be easily moved, on demand, from an arbitrary position to one of the preset positions or one of the non-preset positions. The repositioner **148** can be conveniently provided as a part of control unit programming. In a hybrid camera **10**, one use of preset modes is to allow for easy vane movement to positions corresponding to film cropping formats, such as C, H, and P formats for Advanced Photo System™ film.

Detents can also be provided by controller programming that creates a "dead zone" on the cropper input element **146** in the vicinity of each preset aspect ratio so that all control settings in the vicinity of the preset aspect ratio will produce to the exact ratio of the preset aspect ratio. Aspect ratio changes remain continuous outside the dead zones. An indication can be provided on the information display or in some other manner to show the user when a particular preset aspect ratio has been selected by the cropping control knob. The control unit can alternatively limit aspect ratio changes to the presets in particular capture modes, such as film capture without archival digital capture.

In addition to altering the vane position, the repositioner can change other camera features so as to define specific photography modes. For example, the repositioner can have a portrait mode that moves the vanes **132**,**134** to a preselected vertical aspect ratio and simultaneously zooms a zoom taking lens in so as to fill the frame. This would encourage a high-quality portrait while allowing the photographer to stand a comfortable distance away from the subject. Another example is a panoramic mode that moves the vanes **132**,**134** to a long horizontal aspect ratio while also zooming a taking lens to a wide view angle. In both of these examples, a zoom viewfinder lens coupled to the taking lens or a viewfinder zoom mask **530** (discussed below) is desirable to aid the user in composing pictures. These features can be implemented in software of the controller **81**.

Some of the aspect ratios provided by the cropper **130** can be more extreme than standard photographic formats. Such high-aspect ratio photographs are useful for special-purpose images such as borders of composite image, use along the bottom or side of letterhead, and the like. The cropper **130** has the advantage that the final image aspect ratio can be seen clearly at capture time, allowing the photographer to adjust view direction and camera **10** angle as necessary to capture the desired image content. As earlier mentioned, in some cases such as extreme aspect ratios, it may be desirable to use a transparent material for the vanes **132**,**134**, so that the photographer can more easily ascertain included and excluded scene features.

Referring now to FIGS. **10-20**, in particular embodiments an extension **150**,**152** is joined in fixed (immobile) relation to or continuous with each of the vanes **132**,**134**, respectively. (The term "vane-extension" is used herein to refer to the combination of a vane **150**,**152** and the respective extension **132**,**134**.) Each extension **150**,**152** has one or more guide portions **154**. The cover has one or more guide sections. The guide sections **156** allow linear movement of the guide portions **154** along the guide sections, but permit little or no side-to-side movement within the guide sections **156**. In the illustrated embodiments, the guide portions **154** are shaped like pins that extend outward from the respective extension **150**,**152** into the respective guide section. Two parallel guide sections **156** in the cover are each shaped like a narrow rectangle or oval and can be in the form of a groove recessed in the respective cover or a inwardly extending rim that stands proud of the rest of the cover. Two pin-shaped guide portions **154** slide along a respective guide section **156**. The guide portions **154** and guide sections **156** can have other shapes. For example, the guide sections **156** can be shaped like pins and the guide portions **154** can provide tracks in the form of slots. Likewise, a linear bearing could be used in place of a guide portion **154** and respective guide section **156**.

The extensions **150**,**152** and vanes **132**,**134** are blocked by backing **158** from moving away from the front cover. In the embodiments shown in the figures, the backing **158** is in the form of separate flanges that extend along respective extensions **150**,**152** and vanes **132**,**134**. Thus, the extensions **150**, **152** and vanes **132**,**134** are trapped between the backing **158** and the cover. The configuration of the backing can be changed. For example, the backing can be a continuous plate attached to one or both covers or can be part of the frame **32**.

The extensions **150** are mechanically coupled to move the vanes **132**,**134** in tandem. In the embodiment of FIGS. **10-18**, each extension **150** has a linear rack **160** and the cropper **130** has a pinion **162** that is meshed with both racks **160**. The axle of the pinion is held by a cup **163** (shown in FIG. **17**) molded in the cover and a matching cup (not shown) in the backing **158**. The cups prevent translation of the pinion relative to the cover. Both racks **160** are meshed with the pinion **162**. The pinion **162** couples the motion of the two vanes **132**,**134**, synchronizing them in opposite directions.

In FIG. **10**, the pinion **162** is rotated, clockwise and counter-clockwise, by a primary gear **164** to move the vanes **132**,**134** between positions. The primary gear **164** is joined in fixed (immobile) relation to the pinion **162**. The primary gear **164** is meshed with a secondary gear **166** that is joined in fixed relation to a motor **144** or the shaft of a cropper input element in the form of a rotatable knob (not shown). In FIG. **11**, the cropper input element **146** is a finger wheel that replaces the primary gear **164** that drives the pinion **162**.

The backing **158**, shown in FIGS. **31-33**, holds guide portions **154** of the two extensions **150** against the guide sections **156** and the pinion **162** in the cup (not shown). The guide portions **154** are constrained by the guide sections **156** and backing **158**, limiting movement of each of the vanes **132**,**134** (within manufacturing tolerances) to sliding in a direction parallel to the respective guide sections. The vanes **132**,**134** lie in two parallel overlapping planes. This spacing can be provided by an offset in one of the guide sections **156**, as shown in FIG. **31**, or a step in one of the extensions **150** (not shown), or in some other manner.

The pinion **162** can be driven through a gear train to achieve desired ratios between cropper input element motion and vane motion. For example, a gear train can be used in place of pinion **162**, if desired, to reduce the size or relocate the finger wheel or to adjust the mechanical advantage, or to provide a combination of these effects. The pinion **162** can have a larger diameter. The primary gear **164** or finger wheel can be reduced to a sector to reduce bulk.

The position of mechanically driven vanes **132**,**134** during use, can be held by internal resistance of the various parts, if the user removes a finger or otherwise momentarily stops vane movement. Alternatively, a slip clutch **186** can bear against a vane or extension or other part to prevent unintended movement of the vanes. A wide variety of slip clutches are well known to those of skill in the art. For example, in the embodiment shown in FIG. **32**, the slip clutch **186** is a pair of compression springs **192** and a pair of pressure elements **194** pressed by the compression springs **192** against a cropper input element **146** of the type shown in FIG. **11**. The compression springs **192** and pressure elements **194** are selected to allow required movement of the cropper input element **146**.

The relative position of the vanes **132**,**134** and extensions **150** can be varied to accommodate differently located viewfinders and to adapt to particular camera body shapes and available space. The guide sections **156** can be located at different places relative to the viewfinder and can be slanted toward the upper right instead of the upper left. This allows different locating of the mechanism in the camera body **12**. The extensions can be reshaped as necessary to meet spatial limitations of a particular embodiment. The vanes **132**,**134** and respective extensions **150**,**152**, which are one-piece plastic castings in the illustrated embodiments, can also be made as two separate parts that are mechanically coupled together.

In the embodiment shown in FIG. **10**, the gears **164**,**166** are bevel gears. (In this drawing, as in many other drawings herein, gear teeth may not be shown.) These and other mechanical features can be changed. For example, mounting features can be provided in other parts than one of the covers **28**,**30**, such as the chassis **32** or an intermediate plate (not shown). The gears and gear trains disclosed herein can be replaced by like mechanical components, such as friction wheels and friction wheel trains. Belts, toothed or smooth, and sprockets are other types of mechanical features that can also be used in a modified mechanism.

In a particular embodiment, shown in FIGS. **17-18** and **34**, the camera **10** has a lens cover **174** that is movable between an open position and a closed position. (FIG. **18** illustrates the closed position, in which the lens cover **174** covers an opening **175** in the front cover **28** for the taking lens.) The lens cover **174** has a handle **182** that rides in a through-slot **176** in the front cover **28** of the body **12**. The lens cover **174** is held in place by a slip clutch **186** and/or backing (not shown), in the same manner as the other components earlier discussed.

The lens cover **174** and a modified extension **150***a* act as a default repositioner. The lens cover **174** has a main portion **178** and a cam follower **180** joined to the main portion **178**. The lens cover **174** is spaced from the capture light path in the open position (not shown). The main portion **178** occludes the capture light path when the lens cover **174** is in the closed position (shown in FIG. **18**). A handle **182** of the lens cover **174** protrudes through the front cover **28** and is manually movable to open or close the lens cover **174**.

The extension **150***a* of the lower vane **132** has a cam surface **184** that is matched to the shape of the cam follower **180**. In the embodiment shown in FIG. **17-18**, the cam follower **180** chocks the lower vane **132**, braking cropper **130** movement, when the lens cover **174** is in the closed position. When the lens cover **174** is moved from the open position to the closed position, the cam follower **180** engages the cam surface **184** and drives the vanes **132**,**134** to the center intermediate position. When the lens cover **174** is in the open position, the taking lens **76** is uncovered and the vanes **132**,**134** are movable through their entire range of travel. Movement of the lens cover **174** to the closed position centers a mechanically linked cropper input element **146**. This can be problematic if the knob of the cropper input element **146** is gripped, at that time, by the user. A slip clutch can be provided in the knob to resolve this problem. Reset of vane position to a default after every exposure can be provided by suitable programming of the controller **81**.

Referring now to FIG. **28**, in particular embodiments of the invention, a zoom masking mechanism **530** is mounted in the body **12** of the camera **10**, in addition to the cropper **630**. The two mechanisms together control the viewfinder window **136**. The zoom masking mechanism **530** reduces the size of the window **136** while maintaining a constant aspect ratio. The cropper **630** modifies the shape of the window **136** by changing the aspect ratio.

The zoom mask **530** has pair of opposed L-shaped zoom arms **532**, **534**. The zoom mask arms have zoom mask extensions **550**, **552**. These extensions have zoom guide portions **554** that engage zoom guide sections **556**. The zoom guide sections **556** are attached to the camera body **12**. The directions of movement of the guide portions **554** of the zoom mask extensions **550**,**552** are indicated by arrow **537**. The extensions each have a zoom rack **560** that engages a zoom pinion **562**, which couples the zoom mask arms **532**,**534** to move in opposite directions. The zoom pinion **562** is attached to a zoom primary gear **564**, which is driven by a zoom secondary gear **566**, which is in turn driven by a zoom motor **544**.

The cropper **630** has pair of opposed L-shaped cropper vanes **632**, **634**. The cropper vanes have cropper extensions **650**, **652**. The cropper also has a pair of cropper links **680**, **682**. The cropper links have guide portions **684**, which engage guide sections **686** in the cropper extensions **650**,**652**. The links have additional guide portions **688** that engage cropper guide sections **156**, attached to the camera body **12**. The directions of movement of the guide portions **688** of the links **680**, **682** are indicated by arrow **137**. The cropper links each have a cropper rack **660** that engages the cropper pinion **162**, which couples the links **680**, **682** to move in opposite directions. The cropper pinion **162** is attached to a cropper primary gear **164**, which is driven by a cropper secondary gear **166**, which is in turn driven by a cropper motor **144**.

The cropper vanes **632**, **634** have guide portions **654** which engage guide sections **656** attached to the zoom arms **532**, **534**. The guide sections **656** and guide portions **654** constrain the cropper vanes **632**, **634** to move parallel to arrow **137**, when the zoom arms **532**, **534** are held in a fixed position. The guide portions **684** and guide sections **686** constrain the cropper vanes **632**, **634** to move in tandem with the cropper links **680**, **682**. Because of the linkage of the various racks, pinions, and guides, the cropper vanes **632**, **634** move in opposite directions parallel to arrow **537** when the zoom motor **544** turns, and these same vanes move in opposite directions parallel to arrow **137** when the cropper motor **144** turns.

FIGS. **28**-**30** show how this mechanism can adjust both zoom and aspect ratio as seen through the viewfinder. FIG. **28** shows the mechanism in the fully zoomed out position, with a square aspect ratio.

FIG. **29** shows the mechanism after the zoom motor **544** has turned, causing the zoom primary gear **564** and attached zoom pinion **562** to rotate counter-clockwise. This causes the zoom arms **532**, **534** to move in opposite directions, parallel to arrow **537**. The cropper vanes **632**, **634** follow this motion, which causes the viewfinder window **136** to become smaller while maintaining its square aspect ratio.

FIG. **30** shows the mechanism in the zoom configuration of FIG. **29**, but after the cropper motor **144** has turned. When the cropper motor **144** turns, the cropper primary gear **164** and cropper pinion **162** to turn counter-clockwise. This causes the links **680**, **682** to move in opposite directions, parallel to arrow **137**. The cropper vanes **632**, **634** follow the links, resulting in a change in the aspect ratio of the viewfinder window **136**.

Referring now to FIG. **19**, in particular embodiments, the cropper **130** has a lever-based mechanism controlled by a sliding cropper input element **146**. This mechanism is similar to those earlier discussed, except that gearing is replaced by levers. A main lever **206** is pinned at a centerpoint to the camera cover **28** or **30**. The main lever **206** is pivotable about an axle **208** that extends through the centerpoint. The axle **208** can be held in position by a cup in the same manner as the pinion **162**, earlier discussed. The extensions **150** again have guide portions **154** that ride in guide sections **156** formed in the cover and are held in place in the same manner as in earlier embodiments. The guide portions **154** and guide sections **156** constrain the movement of the vanes **132**,**134** to sliding in directions indicated by arrow **137**.

The extensions **150**,**152** each have a secondary guide portion **210** that interacts with a secondary guide **212** provided at each end of the main lever **206**. The secondary guide portion **210** and secondary guide **212** can be provided in the same manner as the guide portions **154** and guide sections **156** earlier discussed. In the illustrated embodiment, the secondary guide portions **210** are pins and the secondary guides **212** are slots that receive the pins. The main lever **206** has a main lever guide **214** that interacts with a traversing guide **216** on the sliding cropper input element **146**. In the illustrated embodiment, the main lever guide **214** is a pin and the traversing guide **216** is a slot that receives the pin. The sliding cropper input element **146** is a knob having an elongated neck **218** that extends into the body **12**. The neck **218** includes the traversing guide **216**. The main lever **206** is moved by the knob **146**. The main lever **206**, in turn, drives the vane-extensions with the motion coupled, and synchronized in opposite directions. FIG. **19** shows the cropper **130** in a center intermediate position.

A variety of different kinds of electrical switch types can be used as the cropper input element **146**. The cropper input element **146** can have two states. In this case, the controller **81** retains the vane position in one state and cycles the position of the vanes step by step in one direction or back and forth, in the other state. This approach is not preferred, since it is relatively slow and cumbersome. Another alternative is three states. In this case, there are two active states, for stepping the vanes up and down, respectively. Both of these approaches can be modified to change positions faster if the input element is retained in one of the active states or is rapidly actuated. This allows the user to quickly change to a desired range of positions and then more slowly select a position within that range. The position of the input element can also map to a particular vane position. This is convenient for mechanical input elements and can also be provided with electrical input elements.

Referring to FIG. **10**, in particular embodiments, the photographer changes vane position by moving a knob-shaped cropper input element **146** to change the position of a switch (not separately illustrated). The user rotates or slides the cropper input element in either of two opposed directions to alter the vane positions. Each position of the cropper input element **146** can correspond to a specific position of the vanes and, thus, a specific aspect ratio. Alternatively, the vane positions can change stepwise as the cropper input element is actuated, with the rate of alteration of the vane positions proportional to speed of movement or extent of deflection of the cropper input element. A touch pad or other force sensitive input device can be used in the same manner as the rotary or slide switch.

It is preferred that the user be able to manipulate the knob of the switch with a single finger or thumb, without repositioning of the digit. This makes use intuitive and frees up the user's attention for composition and subject matter issues. For this reason and other limitations, a pair of button switches (not shown) may be used as the cropper input element **146**, but are not preferred.

Referring again to FIG. **10**, in use, the photographer moves the knob, which activates the switch and sends an electrical signal to the controller, which process this signal and sends an appropriate signal to the motor, which turns the mechanism in the required direction and changes the position of the vanes **132**,**134**.

It is preferred that the cropper input element **146** is movable between two opposed cropping control positions. Those positions define a cropping control axis **228**. In the embodiment of FIG. **10**, the cropper input element **146** slides (indicated by double-headed arrow **228***a*) between the two positions. The cropper input element **146** rotates (indicated by double-headed arrow **228***b*) between the two positions. In some embodiments, the camera **10** includes a zoom taking lens that is movable independent of the cropper **130**. In those embodiments a zoom input element is disposed on the outside of the shell of the body **12**. The zoom input element is movable between two opposed zoom control positions. Those positions define a zoom control axis.

It is preferred that the cropping control axis **228** is perpendicular to the optical axis **77** of the capture unit and that the zoom control axis **230** is parallel to the optical axis **77** and perpendicular to the cropping control axis **228**. This approach has the advantage that movement of the zoom control is intuitive. The front to back/back to front zoom control axis **230** corresponds to out and in zooming movements. The side-to-side orientation of the cropping control axis **228** is somewhat intuitive of the cropping process. The movement of the cropper input element **146** can reinforce this further by following a track along the camera that resembles the changed position of the edges of the window. This is shown in FIG. **1**.

The cropper input element **146** is switched between positions by manipulation at or toward one side or the other of the camera **10**, to alter positions in one direction or other direction. The specific manipulation required in each case can vary. For example, the cropper input element **146** can have two downwardly depressible buttons aligned along the cropping control axis, or a rocker switch or pivotable wheel or pivotable sector aligned so as to pivot from side-to-side. The zoom input element can be provided in the same ways as the cropper input element **146**, but in a front-back direction. Both input elements can be provided in a like manner or differently.

Referring now to FIG. **27***a*, in a particular embodiment, the cropper input element **146** is a wheel or sector that pivots from side-to-side and the zoom control is a pair of depressible buttons aligned with the middle of the cropper input element **146**. This kind of cropper input element **146** mechanically coupled directly to the vanes **132**,**134** is convenient and relatively simple.

In the embodiment of FIG. **11**, the cropper input element is in the form of a manually operated finger wheel or sector that is rotated clockwise to cropping toward the first position and is rotated counter-clockwise to crop toward the second position. The finger wheel can be partially cut away to reduce bulk.

In particular embodiments, the cropper input element **146** and zoom input element have a common user interface that allows the user to crop and zoom the viewfinder image by shifting a finger, without removal and repositioning. This is easier to use without looking than some other types of input elements. Referring now to FIGS. **21***a*, **26**, **27***b*, and **27***c*, in particular embodiments, cropping and zooming inputs are provided by a four-way rocker button **188**. The button **188** has four pads **220**,**222**,**224**,**226** arranged in a cross. The button **188** is pivotable about orthogonal control and zoom axes **228**,**230** to actuate any of four switches **232**. In the embodiment shown in FIG. **26**, springs **234** bear against the switches **232** and an underlying portion of the cover **28** and together bias the button **188** toward a neutral position and the switches toward an open state. Many variants of this four-way button will be apparent to those of skill in the art. For example, FIG. **27***b* shows a button **234** which can pivot in any direction relative to a vertical axis (coming out of the page in FIG. **27***b*). The rocker button **234** can be pressed in a diagonal direction to change zoom and cropper mechanisms simultaneously. FIG. **27***d* is a modification, in which a four-way force-sensing switch **236** replaces the four-way rocker button. FIGS. **27***c* and **26** are another modification in which a shutter release **22** is disposed in the center of the rocker button **188**. (The shutter release switch **238** is shown in simplified form. A two stroke switch, as earlier discussed, is applicable here.) The rocker button **188**, in this case, can be configured to require a low amount of force to change positions, with the shutter button **22** configured to require a greater amount of force. FIG. **26** illustrates, in diagrammatical form, an example of such a button and circuitry to the controller **81**.

FIGS. **21**-**25** show the effect of using these controls. FIGS. **21***a*, **22***a*, **23***a*, **24***a*, and **25***a* show the top view of a camera with a zoom and crop mechanism controlled by a four-way rocker button **188**. The shutter button **22** is separate in this embodiment. Pressing any of the four pads on the rocker button **188** changes the appropriate camera setting, and pressing the pad again or holding the pad down continues to change the setting until the limit is reached. FIGS. **22***b*, **23***b*, **24***b*, and **25***b* show the result of pressing individual pads until the setting limit is reached.

In FIG. **21***a*, the current camera settings are the normal zoom position and center intermediate cropper position. FIG. **21***b* shows the image seen in the viewfinder for an example photographic situation. In this view, three full-height people can be seen.

FIG. **22***a* shows the effect of pressing the front pad of the rocker button **188**. This commands a control input along the zoom control axis **230**, which drives the optical zoom lens and viewfinder optics to zoom in and display the image shown in FIG. **22***b*, which shows an enlarged view of the torso of the center person in the scene.

FIG. **23***a* shows the effect of pressing the left pad of the rocker button **188**. This commands a control input along the cropping control axis **228**, which drives the cropper vanes to produce the view shown in FIG. **23***b*. In this view, the center person can still be seen at the same full-height magnification, but the people on the left and right are cropped out of the image.

FIG. **24***a* shows the effect of pressing the right pad of the rocker button **188**. This commands an opposite control input along the cropping control axis **228**, which drives the cropper vanes to produce the view shown in FIG. **24***b*. In this view, the magnification remains the same and all three people remain visible, but the legs of the people are cropped out of the image. Note that in order to obtain this view, the photographer had to adjust the view direction slightly, since the subject matter of interest was not centered in the original view. The opportunity to adjust view direction in response to cropping considerations is one of the advantages of the invention.

FIG. **25***a* shows the effect of pressing the back pad of the rocker button **188**. This commands a control input along the zoom control axis **230**, this time in the zoom out direction. This command drives the optical zoom lens and viewfinder zoom optics to display the image shown in FIG. **25***b*, which shows a wide angle view of the scene which includes additional people and a large building in the background.

The cropper input element **146** is operated prior to image capture to aid the photographer in capturing a scene. The cropper **130** includes one or more sensors that detect the position of the vanes **132**,**134** or movement of the vanes **132**,**134** between the positions. The image captured is indicated by the status of the sensors at the time of capture. The control unit receives signals from the sensors and, in response crops an electronic image to match said window formed by the vanes **132**,**134** in the current position. The manner of cropping can be varied. For example, the control unit can crop the archival image, immediately after capture, and save the archival image as cropped. Alternatively, an evaluation image can be cropped and displayed to the user for review. The archival image can be cropped and then saved when the user takes an action or fails to act within a default time period. The archival image can be saved without cropping, but with incorporated metadata that provide cropping instructions. The use of metadata instructions in image files is well known to those of skill in the art. With a film camera **10** or film-digital hybrid camera **10**, similar instructions can be supplied with images. The use of such instructions is also well known to those of skill in the art. For example, instructions can be provided in a magnetic layer or by optical encodement, as with Advanced Photo System™ films.

In addition to evaluation images and archival images, preliminary images can also be cropped when shown on the camera display **26**. This allows use of the display **26** as an electronic viewfinder, in alternation with or simultaneously with an optical viewfinder **58**. Just as the viewfinder vanes **132**,**134** can be either opaque or translucent, the image shown on the display **26** can either completely omit the cropped areas (simulating the opaque vanes **132**,**134**), or show the cropped areas differently, such as with lower contrast (simulating the translucent vanes **132**,**134**).

The cropping provided after capture can be reversible or irreversible. Reversible cropping can be provided by the inclusion of metadata within a digital image (image file or files) that indicates cropping boundaries. Alternatively, information necessary to restore a cropped image can be stored with the cropped image. The provision of metadata of this type within image files is well known to those of skill in the art. The cropping can alternatively be irreversible. In this case, the cropped portions of the image are not saved in long term memory **54**.

The irreversible cropping can occur at any stage in the process of capture and storage of the digital image. For example, reading of a CMOS imager **24** can be limited to the uncropped image area, or an uncropped image in memory **54** can be replaced with the corresponding cropped image. Cropping can also be initially reversible and later irreversible. For example, the cropped portions or uncropped copies of the digital images can be temporarily saved prior to later discard. For example, irreversibly cropped digital images can be saved in removable memory **54** and uncropped copies of the cropped images can be saved in non-removable camera memory **54**. When the removable memory **54** is removed, the uncropped copies can be automatically discarded.

The cropped images can automatically be output as photographic prints or other final images, in cropped form, using appropriately configured output equipment. Use of metadata to determine the format of printed final images is well known in the art. With irreversibly cropped images, a wide variety of aspect ratios can be present in a set of captured images. Fitting the images to a standard output size in photofinishing equipment can be resolved by chopping paper of a standard width to an arbitrary length corresponding to the photographer's desired aspect ratio for each image. An alternative approach is automatically grouping images and then printing the grouped images as a single sheet, for example, as a printed album page. Images intended for printing only after further manipulation, such as narrow aspect ratio images intended for use on letterhead, can be displayed to the user in the captured and stored aspect ratio and can then be further modified, if desired. The cropped images can also be automatically displayed in cropped form on electronic image displays **26**.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

The invention claimed is:

**1**. A camera viewfinder system comprising:

(a) a viewfinder defining a viewfinder axis and having an adjustable zoom setting;

(b) a single user interface comprising:

(i) a cropping control movable in a direction perpendicular to said viewfinder axis to a plurality of positions between two opposing limits, with movement of the cropping control changing an aspect ratio in the viewfinder and

(ii) a zoom control movable in a direction parallel to said viewfinder axis to change said zoom ratio,

wherein movement of both controls is performed while continuously retaining one finger in contact with said cropping control.

**2**. The camera viewfinder system of claim **1**, wherein said cropping control and said zoom control cause an image captured by a camera having the camera viewfinder to have an appearance that corresponds to the appearance of the image in the viewfinder.

**3**. The camera viewfinder system of claim **1**, wherein said cropping control and zoom control are further movable to another position for indicating a time for capturing an image wherein movement of both controls and movement to the capture position is capable of being performed while continuously retaining one finger in contact with said cropping control.

**4**. The camera viewfinder system of claim **1**, wherein said cropping control comprises a rocker button movable from a neutral position to one of four positions including a first position for increasing zoom, a second position for decreasing zoom, a third position for decreasing an extent of cropping and a fourth position for increasing an extent of cropping.

**5**. The camera viewfinder system of claim **1**, wherein said cropping control comprises a force sensing switch that can sense a direction of applied force.

**6**. The camera viewfinder system of claim **1**, wherein said cropping control comprises a rocker button movable from a neutral position to positions including a first position for increasing zoom, a second position for decreasing zoom, a third position for decreasing an extent of cropping and a fourth position for increasing an extent of cropping, said positions also include at least one intermediary position between one of the first, second, third and fourth positions.

7. A camera system comprising:

an archival image capture unit;

a viewfinder presenting a view of a scene that is cropped and zoomed within a range of extent of zoom and crop;

the archival image capture unit capturing an image of a scene and providing an image that has been zoomed and cropped;

a user input control movable between a neutral position and at least four positions relative to the neutral position in a manner that allows a user to make such movements using a finger and without removing said finger from the control; and

a controller adapted to receive signals from the user input control, with an extent of zoom adjustable to a greater extent when the user input control is moved to a first of the positions, with the extent of the zoom adjustable to a lesser extent when the user input control is moved to a second of the positions wherein the extent of crop is increased when the user input control is moved to a third of the positions and an extent of crop is decreased when the user input control is moved to a fourth of the positions,

wherein said controller uses the signals from the user input control to adjust cropping and zooming of the viewfinder and to cause the appearance of an image captured by the archival image to be adjusted to match the appearance of the scene provided by the viewfinder.

**8**. The camera of claim **7**, wherein said controller uses the signals from the user input control to adjust cropping and zooming of the viewfinder and to cause the appearance of an image captured by the archival image to be adjusted to match the zoom and crop adjustments made to the viewfinder image.

**9**. The camera of claim **7**, wherein said user input control is further movable between the neutral position, at least four positions relative to the neutral position and a fifth position indicating a desire to capture an image without further adjustment of the zoom and crop, with said user input control being movable between all five positions in a manner that allows a user to make such movements using a finger and without removing said finger from the user input control.

**10**. The camera of claim **9**, wherein movement to the fifth position is made along and axis that is different than movement to the first four positions.

**11**. The camera of claim **9**, wherein an additional switch is provided in the center of the user input control to enable movement to the fifth position.

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